THESIS - SS142501

HIERARCHICAL FORECASTING OF CURRENCY INFLOW AND OUTFLOW IN BANK INDONESIA BASED ON HYBRID ARIMAX-ANN MODEL

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PERAMALAN HIRARKI *INFLOW* DAN *OUTFLOW* UANG KARTAL DI BANK INDONESIA BERDASARKAN MODEL *HYBRID* ARIMAX-ANN

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HIERARCHICAL FORECASTING OF CURRENCY INFLOW AND OUTFLOW IN BANK INDONESIA BASED ON HYBRID ARIMAX-ANN MODEL

A thesis submitted in partial fulfillment of the requirements for the degree of Magister of Science (M.Si.)
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HIERARCHICAL FORECASTING OF CURRENCY INFLOW AND OUTFLOW IN BANK INDONESIA BASED ON HYBRID ARIMAX-ANN MODEL

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ABSTRACT

The aim of this study is to find the best method for forecasting monthly currency inflow and outflow data in Bank Indonesia. The inflow or outflow data is a hierarchical time series that has some levels, i.e. branch offices, islands, and national level. Hierarchical time series forecasting requires special treatment to make the forecasts follow the hierarchy structure. This study compared the performance of hierarchical forecasting methods including bottom-up, top-down and optimal combination method. Those methods were implemented on the base forecast obtained individually by using the best model between ARIMAX and hybrid ARIMAX-ANN. The method performance were evaluated based on out-of-sample RMSE. The results showed that in obtaining base forecasts of 46 series of each inflow and outflow, the hybrid method could increase the accuracy of 97.8 and 87.0 percent of ARIMAX model for inflow and outflow respectively. The accuracy improvement of ARIMAX models were up to 10.26 and 10.65 percent respectively on inflow and outflow series. Moreover, the hybrid method also reduced the number of series that has heteroscedasticity. In the hierarchical forecasting, the top-down and optimal combination method performed well if the base forecasts were only based on ARIMAX. If the base forecasts were obtained by using the best model for each series, which are more accurate, the bottom-up method could outperformed the other methods for both hierarchical currency inflow and outflow data. Finally, the interval of final forecast were constructed by using the error variance, which are estimated based on MSE and GARCH respectively for series with homoscedasticity and heteroscedasticity. The interval forecast based on GARCH model will not certainly become wider over time and tend to be narrower or more precise compared to the interval based on MSE, especially for long period of forecasting.

Keywords: hierarchical time series, bottom-up, top-down, optimal combination, ARIMAX, hybrid ARIMAX-ANN, interval forecast.

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PERAMALAN HIRARKI *INFLOW* DAN *OUTFLOW* UANG KARTAL DI BANK INDONESIA BERDASARKAN MODEL *HYBRID* ARIMAX-ANN

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ABSTRAK

Tujuan penelitian ini adalah untuk mendapatkan metode terbaik untuk meramalkan *inflow* dan *outflow* uang kartal bulanan di Bank Indonesia. Data *inflow* maupun *outflow* merupakan data deret waktu hirarki dengan beberapa tingkatan, yaitu data tingkat kantor perwakilan wilayah, kepulauan, dan tingkat nasional. Untuk meramalkan data hirarki diperlukan perlakuan khusus agar dihasilkan ramalan yang mengikuti struktur hirarki. Penelitian ini membandingkan performa dari beberapa metode hirarki, antara lain *bottom-up*, *top-down* dan kombinasi optimal. Setiap metode tersebut diterapkan pada ramalan dasar yang diperoleh menggunakan model terbaik antara ARIMAX dan *hybrid* ARIMAX-ANN. Performa masing-masing metode dibandingkan berdasarkan kriterie RMSE untuk data *out-of-sample*. Hasil yang diperoleh menunjukkan bahwa dalam mendapatkan ramalan dasar, metode *hybrid* dapat meningkatkan akurasi sebanyak 97,8 dan 87,0 persen dari total 46 series untuk masing-masing *inflow* dan *outflow*. Besar peningkatan akurasinya mencapai 10,26 dan 10,65 persen masing-masing untuk *inflow* dan *outflow*. Selain itu, banyaknya data yang mengandung heteroskedastisitas juga berkurang setelah diterapkan metode *hybrid*. Dalam peramalan hirarki, metode top-down dan kombinasi optimal baik digunakan jika ramalan dasar didapatkan hanya dari model ARIMAX. Jika digunakan model terbaik untuk masing-masing data, metode *bottom-up* adalah metode terbaik untuk data hirarki inflow maupun outflow. Selanjutnya, ramalan interval dihitung dengan menggunakan varians *error* yang diestimasi berdasarkan MSE dan GARCH, masing-masing untuk data dengan homoskedastisitas dan heteroskedastisitas. Ramalan interval berdasarkan GARCH cenderung lebih sempit atau lebih presisi dibandingkan dengan ramalan interval berdasarkan MSE, terutama untuk periode yang jauh ke depan.

Kata kunci: data deret waktu hirarki, *bottom-up*, *top-down*, kombinasi optimal, ARIMAX, *hybrid* ARIMAX-ANN, ramalan interval.

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PREFACE

Praises and thanks to the God whose many blessings have made me complete the thesis entitled "Hierarchical Forecasting of Currency Inflow and Outflow in Bank Indonesia Based on Hybrid ARIMAX-ANN Model". This thesis is submitted in partial fulfilment of the requirements for an Indonesian master's degree in science (M.Si.). It contains work done from January to July 2016. Writing this thesis has been hard and required a lot of patience but in the process of writing, I feel I have learned a lot.

I would like to express my deep and sincere gratitude to my research supervisors, Dr. Suhartono and Santi Puteri Rahayu, Ph.D. for providing me invaluable guidance and inspiration throughout this research and their support for the research publications. I would also like to thanks Dr. Setiawan and Dr. Wahyu Wibowo as my examiners, for their very helpful comments and suggestions about my thesis.

I would like to thank the Ministry of Research, Technology and Higher Education of the Republic of Indonesia for its financial support through BPPDN Fresh Graduate scholarship, which has supported me completing master studies at ITS.

I am extremely grateful to my parents and my brother for their love, prayers, caring, sacrifices and supports for my education and research works. My deepest thanks are also given to my college friends for the togetherness and knowledge sharing during studies at ITS. My thanks also go to all the people who have supported me to complete this thesis directly or indirectly.

This thesis is far from perfection. Therefore, any comments or suggestions will be very helpful for the future research. Finally, I hope this thesis can be beneficial for the readers.

Surabaya, July 2016

Author

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TABLE OF CONTENTS

TABLE OF TABLES

(*This page is intentionally left blank*)

TABLE OF FIGURES

Page

TABLE OF APPENDICES

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CHAPTER I
INTRODUCTION

1.1 Background

Most of economic transactions still use currency as the instrument of payment. In Indonesia, currency is produced by Bank Indonesia. In order to manage the currency stock in the future, Bank Indonesia needs the accurate forecast of Rupiah deposits (inflow) and Rupiah withdrawals (outflow). Bank Indonesia has 44 branch offices that spread over Indonesia. The currency inflow and outflow data are recorded by branch offices then aggregated to obtain the national inflow and outflow. This makes the data have hierarchical structure, where the top level data is national data and the lowest level data is branch offices data. There are some previous studies about currency inflow and outflow forecasting, such as Ahmad, Setiawan, Suhartono and Masun (2015), Setiawan, Suhartono, Ahmad and Rahmawati (2015), also Reganata and Suhartono (2016). Those researches only analyzed the data individually for some branch offices, not as a hierarchical time series.

Common methods for hierarchical time series forecasting are top-down and bottom-up method. The top-down method involves forecasting the completely aggregated series, and then disaggregating the forecast by using certain procedure. The bottom-up method involves forecasting the lowest level series, and then aggregating the forecast. In case of Bank Indonesia, the top-down method is very efficient because only the national data is needed to be forecasted with appropriate model, while the branch offices forecast can be obtained by disaggregation based on historical or forecasted proportion. However, both methods have its own advantage. The top-down forecasting only makes sense when the aggregated series is made up of components that have similar patterns of variation, while the bottom-up forecasting is better when the bottom series have different patterns of variation (Lapide, 2006).

It is also certainly possible to forecast all series at all level, but the resulted forecast will not maintain the real hierarchical structure. In other words, the top level forecast will not be equal to the sum of the lower level forecast. Hyndman, Ahmed and Athanasopoulos (2011) have introduced an optimal combination method to revise the forecast at all level, so the forecast can follow the hierarchical structure. Their simulation and empirical studies on Australian tourism demand show that this method performs well compared to the top-down and bottom-up method. Whereas, Prayoga, Rahayu and Suhartono (2015) also have applied this method on motorcycle sales data. The results show that the optimal combination method does not always give the best performance. This research is conducted to learn more about the comparison between top-down, bottom-up and optimal combination method.

The base forecasts in hierarchical forecasting can come from any model. However, in order to obtain the best results, an appropriate model is needed. Currently the most powerful time series model is the hybrid model. This model combines the advantages of linear and nonlinear model. As known in general, the linear model have an advantage on its ease of interpretation. On the other hand, the nonlinear model is known has high accuracy, especially for training data, but not interpretable. The hybrid methodology has been introduced by Zhang (2003) by using autoregressive integrated moving average (ARIMA) to model the linear components and using artificial neural networks (ANN) to model the nonlinear components. His empirical results with real data sets show that the hybrid ARIMA-ANN can improve forecasting accuracy achieved by either of the models used separately.

In the case of currency inflow and outflow in Bank Indonesia, the linear components need to be modeled by using calendar variation model with the effect of Eid al-Fitr. It is considering that Indonesia is a country with Muslim majority. This causes many economic data have seasonal patterns that are influenced by two types of calendar, i.e. Christian and Islamic calendar. The Christian calendar effect causes the inflow and outflow high or low in certain month, while the Islamic calendar affects the inflow and outflow in month around Eid al-Fitr holidays. This is called holiday's effect (Liu, 1986; Sullivan, Timmermann, & White, 2001; Seyyed, Abraham, & Al-Hajji, 2005; Alagidede, 2008; Lee, Suhartono, & Hamzah, 2010; Suhartono & Lee, 2011). This holiday's effect cannot be identified as seasonal effect because Eid holidays occur at varying dates and months in Christian calendar from year to year.

Time series analysis for data with calendar variation effect requires special treatment. Common time series analysis, such as decomposition methods and ARIMA models can give incorrect results, especially about seasonal patterns and the emergence of outliers. Liu (1986) has conducted research on the calendar variation. He recommends the modification of ARIMA model by including holiday information as deterministic input. Lee, et al. (2010) introduced a developed time series regression with calendar variation model for Muslim clothing products sales. In addition, Suhartono and Lee (2011) developed a calendar variation model for monthly sales of garment products in a retail company. Those modified ARIMA models are called ARIMAX.

On monthly data, the effect of Eid al-Fitr varies depending on the date Eid al-Fitr happens. To capture this effect, required 30 dummy variables representing each days Eid al-Fitr happens. However, usually not all parameters can be estimated due to the limitation of observation. Therefore, Suhartono, Lee and Prastyo (2015) developed two levels ARIMAX model that can predicts the parameters for every possibility number of days before Eid al-Fitr. Its application on retail sales data with Eid al-Fitr effect showed that the two levels ARIMAX model yielded better forecast compared to the ARIMA and ANN. Considering this, the two level ARIMAX is used to model the linear component of inflow and outflow data.

It is reasonable to consider that a time series data is composed of both linear and nonlinear correlation structures (Zhang, 2003). The ARIMAX model can capture only the linear correlations, so the nonlinear components will remain in the residual. Based on the hybrid modelling procedure, the residual needs to be modelled by using nonlinear model. Artificial neural network is a model that is able to approximate various nonlinearities of the data. The advantage of using ANN is that there is no need to specify a particular model form because the model is adaptively formed based on the features presented from the data (Zhang & Berardi, 1998). ANNs have been widely used for time series forecasting, such as Faraway and Chatfield (1998), also Prayoga et al. (2015).

Time series point forecasting often yields forecasts that are not exactly the same as the actual data. Therefore, interval forecasts are very important to give the stakeholder a confidence level that the forecasts will be within a specific interval. In general, the forecast interval is formed based on the error variance estimated by minimum mean square error (MSE) that assumes constant variance over time. In practice, many economic data are found have heteroscedasticity. In such cases, the use of MSE is not appropriate and the variance needs to be modelled. Generalized autoregressive conditional heteroscedasticity (GARCH) models have been found to be useful for modelling inconstant variance. Some applications and the use of GARCH have been explained by Lamoureux and Lastrapes (1990), also Engle (2001).

Based on the explanation above, this study concerns on forecasting hierarchical data of monthly currency inflow and outflow in Bank Indonesia by using the best hierarchical method between top-down, bottom-up and optimal combination. Those methods employ the best model between ARIMAX and hybrid ARIMAX-ANN model with calendar variation effect to calculate the base forecasts. All models and methods are selected based on the criteria of root mean squared error (RMSE) of out-of-sample data. Finally, the interval hierarchical forecasts are calculated based on the estimate of error variance. Moreover, this study also examines the effect of hybrid modelling and hierarchical forecasting to the presence of heteroscedasticity in terms of the significance of GARCH orders.

1.2 Research Problems

According to the background, there are five main problems of this research, such as:

1. How are the ARIMAX model for each individual series of currency inflow and outflow in Bank Indonesia?
2. How are the performance of hybrid methods in terms of improving the out-of-sample accuracy of ARIMAX models?
3. How is the out-of-sample accuracy comparison between top-down, bottom-up and optimal combination method?
4. How is the presence of heteroscedasticity before and after GARCH modeling?

5. How are the interval of final forecasts for series with homoscedasticity and heteroscedasticity?

1.3 Research Objectives

The objectives of this research is to answer the research problems, i.e.:

1. To model the currency inflow and outflow data by using ARIMAX with calendar variation effect of Eid al-Fitr.
2. To evaluate the performance of hybrid ARIMAX-ANN models by comparing the out-of-sample accuracy of the hybrid models with ARIMAX models.
3. To compare the out-of-sample accuracy of top-down, bottom-up and optimal combination method.
4. To detect the presence of heteroscedasticity before and after hybrid modeling.
5. To describes the interval of final forecasts for series with homoscedasticity and heteroscedasticity.

1.4 Research Benefits

Common time series models for currency inflow and outflow forecasting in Bank Indonesia have not given satisfactory results. The main contribution of this research is to provide the procedure of hybrid modelling by combining ARIMAX, ANN and GARCH, which have high accuracy, but still interpretable to explain the effect of calendar variation by Eid al-Fitr. This research is also very important for Bank Indonesia to provide the procedure of hierarchical forecasting, which can simultaneously forecast the inflow and outflow at all hierarchy level, including national, islands, and branch offices. Hence, the forecast of national inflow and outflow will be equal to the sum of the lower level forecasts.

1.5 Research Limitation

There are some limitations of this study, i.e.:

1. The data used in this study are monthly data of currency inflow and outflow in 40 branch offices of Bank Indonesia.

2. The hierarchical forecasting in this study uses two level hierarchical structure. The levels are determined based on the branch offices, islands and national aggregation, without temporal aggregation.
3. The parameters of ARIMAX models are estimated by using conditional least squares.
4. The type of ANN used is multilayer perceptron with a hidden layer that uses hyperbolic tangent functions.
5. The parameters of ANN models are estimated by using modified resilient backpropagation with the smallest learning rate procedure.
6. The ANN models are trained with 1 to 5 neurons in hidden layer and replicated 500 times for each model.

CHAPTER II
LITERATURE REVIEW

This chapter explain the theoretical review about hierarchical forecasting, ARIMAX modeling, hybrid ARIMAX-ANN modeling and interval forecasting for time series with homoscedasticity and heteroscedasticity.

2.1 Hierarchical Forecasting

Hierarchical time series are some time series that have hierarchical structure with certain level. For example, a hierarchical time series structure with two levels (K=2) can be seen on Figure 2.1.

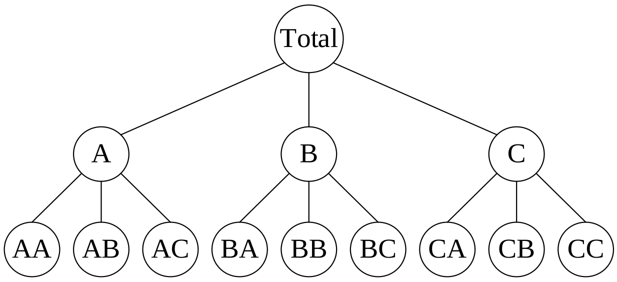

Figure 2.1. Structure of hierarchical time series with two levels.

Considering the hierarchical structure on Figure 2.1, the ”Total” variable is a fully aggregated series that is denoted as ”level 0” series. Variable A, B and C are the first level of disaggregation denoted as ”level 1”, and so on variable AA, AB, ..., CC are the most disaggregated series denoted as ”level 2”. Some notations are used in hierarchical forecasting, such as:

$Y_{\mathrm{X},t}$ = the t-th observation of variable Y_{X}

m = the number of variables at all level hierarchical series.

m_K = the number of variables at the most disaggregated level (level K).

The example on Figure 2.1 has the values of m=13 and m_K=9.

The hierarchical time series structure can be expressed by matrix notation as follows:

$$\boldsymbol{Y}_t = \boldsymbol{S}\boldsymbol{Y}_{K,t} \tag{2.1}$$

which can be elaborated to:

$$\begin{bmatrix} \mathbf{Y}_{\text{Total},t} \\ \mathbf{Y}_{\text{A},t} \\ \mathbf{Y}_{\text{B},t} \\ \mathbf{Y}_{\text{C},t} \\ \mathbf{Y}_{\text{AA},t} \\ \mathbf{Y}_{\text{AB},t} \\ \vdots \\ \mathbf{Y}_{\text{CB},t} \\ \mathbf{Y}_{\text{CC},t} \end{bmatrix} = \begin{bmatrix} 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 \\ 1 & 1 & 1 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 1 & 1 & 1 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 1 & 1 & 1 \\ & & & & & & & & \\ & & & & \boldsymbol{I}_9 & & & & \\ & & & & & & & & \end{bmatrix} \begin{bmatrix} \mathbf{Y}_{\text{AA},t} \\ \mathbf{Y}_{\text{AB},t} \\ \mathbf{Y}_{\text{AC},t} \\ \mathbf{Y}_{\text{BA},t} \\ \mathbf{Y}_{\text{BB},t} \\ \mathbf{Y}_{\text{BC},t} \\ \mathbf{Y}_{\text{CA},t} \\ \mathbf{Y}_{\text{CB},t} \\ \mathbf{Y}_{\text{CC},t} \end{bmatrix}$$

where:

$$\mathbf{Y}_{\text{Total},t} = [Y_{\text{Total},1} \quad Y_{\text{Total},2} \quad \cdots \quad Y_{\text{Total},n}]$$

$$\mathbf{Y}_{\text{A},t} = [Y_{\text{A},1} \quad Y_{\text{A},2} \quad \cdots \quad Y_{\text{A},n}]$$

$$\vdots$$

$$\mathbf{Y}_{\text{CC},t} = [Y_{\text{CC},1} \quad Y_{\text{CC},2} \quad \cdots \quad Y_{\text{CC},n}]$$

and $\boldsymbol{S}$ is the "summing" matrix with order $m \times m_K$ that aggregates the bottom level series all the way up the hierarchy (Athanasopoulos, Ahmed, & Hyndman, 2009).

The aim of hierarchical forecasting is to makes the forecast maintain the real hierarchical structure by revising the individual forecast. The final forecast is obtained by using the following equation (Athanasopoulos et al., 2009)

$$\tilde{\boldsymbol{Y}}_n(l) = \boldsymbol{SP}\hat{\boldsymbol{Y}}_n(l) \tag{2.2}$$

where $\hat{\boldsymbol{Y}}_n(l)$ is the individual l step ahead forecast at all hierarchical level, and $\boldsymbol{P}$ is the proportion matrix based on the hierarchical method used.

2.1.1 Bottom-up Method

The bottom-up approach works by forecasting the most disaggregated series, and then aggregating them to obtain the upper level forecast. The bottom-up forecasting is good when the bottom series have different patterns of variation (Lapide, 2006). In bottom-up forecasting, the $\boldsymbol{P}$ matrix is denoted as:

$$\boldsymbol{P} = [\mathbf{0}_{m_K \times (m - m_K)} \mid \boldsymbol{I}_{m_K}] \tag{2.3}$$

where **0** is a null matrix. The role of ***P*** here is to extract the bottom level forecasts, which are then aggregated by matrix ***S*** to produce the upper level forecasts (Athanasopoulos et al., 2009).

2.1.2 Top-down Method

The top-down method involves forecasting the completely aggregated series, and then disaggregating the forecast by using certain procedure. This method will makes sense when the aggregated series is made up of components that have similar patterns of variation (Lapide, 2006). In top down forecasting, the proportion matrix is denoted as:

$$\boldsymbol{P} = [\,\boldsymbol{p} \mid \mathbf{0}_{m_K \times (m-1)}] \tag{2.4}$$

where $\boldsymbol{p} = [\,p_1, p_2, ..., p_{m_k}]'$ is a set of proportions of the bottom level series (Athanasopoulos et al., 2009). This ***P*** matrix will disaggregate the top level forecast to forecasts the bottom level series.

The proportions can be determined based on historical proportions or forecasted proportions. There are two types of historical proportions. The first one is named as TDHP1 (top-down historical proportions 1) that consider:

$$p_i = \frac{1}{n}\sum_{t=1}^{n}\frac{Y_{i,t}}{Y_t} \tag{2.5}$$

while the second one is named as TDHP2 (top-down historical proportion 2) that consider:

$$p_i = \sum_{t=1}^{n}\frac{Y_{i,t}}{n} \Bigg/ \sum_{t=1}^{n}\frac{Y_t}{n} \tag{2.6}$$

where i = 1, 2, ..., m_K. The use of historical proportions has advantage that the calculation is simple and very useful for low count data. On the other hand, the disadvantages of this method is the proportions are static and miss any trends in the data.

In order to obtain the more dynamic proportions, the forecasted proportions are used. The top-down forecast based on forecasted proportions are calculated by using:

$$\hat{Y}_{i,n}(l) = p_i \hat{Y}_{\text{Total},n}(l) \tag{2.7}$$

and the general equation for calculating the proportions is:

$$p_i = \prod_{k=0}^{K-1} \frac{\hat{Y}_{i,n}^{(k)}(l)}{\sum_i \hat{Y}_{i,n}^{(k+1)}(l)} \tag{2.8}$$

where $\hat{Y}_{i,n}^{(k)}(l)$ is the l-step-ahead forecast of the corresponding series which is k levels above i, and $\sum_i \hat{Y}_{i,n}^{(k+1)}(l)$ is the sum of l-step ahead forecasts below node k which are directly connected to node k (Athanasopoulos et al., 2009). For example,

$$\tilde{Y}_{\mathrm{A},n}(l) = \left(\frac{\hat{Y}_{\mathrm{A},n}(l)}{\hat{Y}_{\mathrm{A},n}(l) + \hat{Y}_{\mathrm{B},n}(l) + \hat{Y}_{\mathrm{C},n}(l)} \right) \times \hat{Y}_{\mathrm{Total},n}(l)$$

$$\tilde{Y}_{\mathrm{AA},n}(l) = \left(\frac{\hat{Y}_{\mathrm{AA},n}(l)}{\hat{Y}_{\mathrm{AA},n}(l) + \hat{Y}_{\mathrm{AB},n}(l) + \hat{Y}_{\mathrm{AC},n}(l)} \right) \times \tilde{Y}_{\mathrm{A},n}(l)$$

$$\tilde{Y}_{\mathrm{AA},n}(l) = \left(\frac{\hat{Y}_{\mathrm{AA},n}(l)}{\hat{Y}_{\mathrm{AA},n}(l) + \hat{Y}_{\mathrm{AB},n}(l) + \hat{Y}_{\mathrm{AC},n}(l)} \right) \times \left(\frac{\hat{Y}_{\mathrm{A},n}(l)}{\hat{Y}_{\mathrm{A},n}(l) + \hat{Y}_{\mathrm{B},n}(l) + \hat{Y}_{\mathrm{C},n}(l)} \right) \times \hat{Y}_{\mathrm{Total},n}(l).$$

thus the forecasted proportion is:

$$p_{\mathrm{AA},n}(l) = \left(\frac{\hat{Y}_{\mathrm{AA},n}(l)}{\hat{Y}_{\mathrm{AA},n}(l) + \hat{Y}_{\mathrm{AB},n}(l) + \hat{Y}_{\mathrm{AC},n}(l)} \right) \times \left(\frac{\hat{Y}_{\mathrm{A},n}(l)}{\hat{Y}_{\mathrm{A},n}(l) + \hat{Y}_{\mathrm{B},n}(l) + \hat{Y}_{\mathrm{C},n}(l)} \right).$$

2.1.3 Optimal Combination Method

The optimal combination method use the information from all individual series. This method works by optimally combining the forecasts of series from all hierarchy level by using linear regression as follows:

$$\hat{\boldsymbol{Y}}_n(l) = \boldsymbol{S\beta} + \boldsymbol{\varepsilon} \tag{2.9}$$

where $\boldsymbol{\beta} = \mathrm{E}[\hat{\boldsymbol{Y}}_{K,n}(l) \mid \boldsymbol{Y}_1, \boldsymbol{Y}_2, \ldots, \boldsymbol{Y}_n]$ (Athanasopoulos et al., 2009). The estimator for $\boldsymbol{\beta}$ can be obtained by using ordinary least squares method as follows:

$$\hat{\boldsymbol{\beta}} = (\boldsymbol{S'S})^{-1} \boldsymbol{S'} \hat{\boldsymbol{Y}}_n(l) \tag{2.10}$$

thus the final forecast can be obtained as follows:

$$\begin{aligned} \tilde{\boldsymbol{Y}}_n(l) &= \boldsymbol{S}\hat{\boldsymbol{\beta}} + \boldsymbol{\varepsilon} \\ &= \boldsymbol{S}(\boldsymbol{S'S})^{-1} \boldsymbol{S'} \hat{\boldsymbol{Y}}_n(l) + \boldsymbol{\varepsilon}. \end{aligned} \tag{2.11}$$

According to the general form of hierarchical method in Equation (2.2), the matrix $\boldsymbol{P}$ in optimal combination method is:

$$\boldsymbol{P} = (\boldsymbol{S}'\boldsymbol{S})^{-1}\boldsymbol{S}'. \tag{2.12}$$

2.2 Time Series Regression

Time series are conventionally considered to consist of a mixture of trend-cycle (T_t), seasonal (S_t) and irregular (a_t) components. In time series regression, these components are assumed additive and written as the following model:

$$\begin{aligned} Y_t &= T_t + S_t + a_t \\ &= \mu_0 + \sum_{k=1}^{r} \mu_k U_{k,t} + \sum_{m=1}^{s} \delta_m V_{m,t} + a_t \end{aligned} \tag{2.13}$$

where $T_t = \mu_0 + \sum_{k=1}^{r} \mu_k U_{k,t}$, $U_{k,t}$ are the trend-cycle variables, $S_t = \sum_{m=1}^{s} \delta_m V_{m,t}$, and $V_{m,t}$ are the seasonal variables (Wei, 2006, p. 162). For linear trend, T_t can be written as:

$$T_t = \mu_0 + \mu_1 t \tag{2.14}$$

and for polynomial trend with order r, T_t can be written as (Wei, 2006, p. 162):

$$T_t = \mu_0 + \sum_{k=1}^{r} \mu_k t^k. \tag{2.15}$$

The seasonal component can be described as a linear combination of dummy variables with s seasonal period as follows:

$$S_t = \sum_{m=1}^{s-1} \delta_m M_{m,t} \tag{2.16}$$

where $M_{m,t}$ equals to 1 if t corresponds to the seasonal period m and 0 otherwise (Wei, 2006, p. 162).

Time series regression also can be applied for data with calendar variation effect by adding dummy variables. For example, a time series regression with linear trend, s seasonal period and calendar variation can be written as:

$$Y_t = \mu_0 + \mu_1 t + \sum_{m=1}^{s-1} \delta_m M_{m,t} + \sum_{j=1}^{v} \beta_j H_{j,t} + a_t \tag{2.17}$$

where $H_{j,t}$ is the dummy variable for the j-th calendar variation effect. The number of calendar variation effect can be identified based on the time series plot of the data (Lee et al., 2010).

2.3 Autoregressive Integrated Moving Average (ARIMA)

ARIMA model is a flexible time series model that can capture the effect of autoregressive (AR) and moving average (MA). This model can be applied both for non-seasonal or seasonal data and for stationary or non-stationary data. The general form of ARIMA $(p,d,q)(P,D,Q)^s$ model is:

$$Y_t = \frac{\theta_q(B)\Theta_Q(B^s)}{\phi_p(B)\Phi_P(B^s)(1-B)^d(1-B^s)^D} a_t \tag{2.18}$$

where:

$\phi_p(B) = (1-\phi_1 B - \phi_2 B^2 - .. - \phi_p B^p)$

$\theta_q(B) = (1-\theta_1 B - \theta_2 B^2 - ... - \theta_q B^q)$

$\Phi_P(B^s) = (1-\Phi_1 B^s - \Phi_2 B^{2s} - ... - \Phi_P B^{Ps})$

$\Theta_Q(B^s) = (1-\Theta_1 B^s - \Theta_2 B^{2s} - ... - \Theta_Q B^{Qs})$

B is the backshift operator, s is the seasonal period, a_t is a white noise process with zero mean and constant variance, t = 1, 2, ..., n, and n is the number of observation (Bowerman & O'Connell, 1993, p. 570).

2.4 ARIMAX Model with Calendar Variation Effect

ARIMAX model is an ARIMA model with the addition of exogenous variables (Cryer & Chan, 2008). In terms of modelling the effect of calendar variation, the ARIMAX model can be in the form of time series regression with the addition of ARIMA order. It considers that in real data, the white noise assumption in time series data is often violated, so the ARIMA order needs to be added. The general form of ARIMAX for calendar variation is:

$$Y_t = \mu_1 t + \sum_{j=1}^{v} \beta_j H_{j,t} + \sum_{m=1}^{s} \delta_m M_{m,t} + \frac{\theta_q(B)\Theta_Q(B^s)}{\phi_p(B)\Phi_P(B^s)(1-B)^d(1-B^s)^D} a_t \tag{2.19}$$

where $H_{j,t}$ is the dummy variable for the j-th calendar variation effect and $M_{m,t}$ is the dummy variables for seasonal effect.

Recent development of ARIMAX model is the two level ARIMAX developed by Suhartono et al. (2015). This model is very useful especially for monthly data to capture the effect of the number of days before holydays. The first level of two level ARIMAX model has the same form as Equation (2.18), where j explains the number of periods before holidays in corresponding months. For example, the two level ARIMAX model with calendar variation effect by Eid al-Fitr on monthly data is:

$$Y_t = \mu_1 t + \sum_{j=0}^{30} \beta_j H_{j,t} + \sum_{m=1}^{s} \delta_m M_{m,t} + \frac{\theta_q(B)\Theta_Q(B^s)}{\phi_p(B)\Phi_P(B^s)(1-B)^d(1-B^s)^D} a_t. \quad (2.20)$$

In many cases, the length of time series are limited, so not all β_j can be estimated in the first level model. This becomes problem when the forecasting is done, because the forecasting often needs the values of the unknown β_j. Therefore, the second level model are needed to predict the β_j for every possibility number of days before holidays. As the second level model, a linear function can be applied as follows:

$$\hat{\beta}_j = \omega_0 + \omega_1 j \quad (2.21)$$

where j is the number of days before Eid holidays in corresponding month. In this model, the response variable is the estimated values of β_j in Equation (2.19).

2.4.1 ARIMAX Order Identification

The ARIMA order of two level ARIMAX model can be determined by firstly modelling the time series regression, then identifying the autocorrelation and partial autocorrelation of the residual (Suhartono et al., 2015). The autocorrelation function (ACF) is (Wei, 2006, p. 10):

$$\rho_k = \frac{\mathrm{Cov}(Y_t, Y_{t+k})}{\sqrt{\mathrm{Var}(Y_t)}\sqrt{\mathrm{Var}(Y_{t+k})}} = \frac{\gamma_k}{\gamma_0} \quad (2.22)$$

where:

ρ_k = autocorrelation at k-th lag,

k = 1,2,3,...

$\text{Cov}(Y_t, Y_{t+k}) = \text{E}(Y_t - \mu)(Y_{t+k} - \mu) = \gamma_k$

$\text{Var}(Y_t) = \text{Var}(Y_{t+k}) = \gamma_0$.

The sample autocorrelation is (Wei, 2006, p. 20):

$$\hat{\rho}_k = \frac{\hat{\gamma}_k}{\hat{\gamma}_0} = \frac{\sum_{t=1}^{n-k}\left(Y_t - \bar{Y}\right)\left(Y_{t+k} - \bar{Y}\right)}{\sum_{t=1}^{n}\left(Y_t - \bar{Y}\right)^2}. \tag{2.23}$$

Partial autocorrelation is the correlation between Y_t and Y_{t-k} after removing the effect of Y_{t+1}, Y_{t+2}, …, Y_{t+k-1}. The partial autocorrelation function (PACF) is:

$$P_k = \frac{\text{Cov}[(Y_t - \hat{Y}_t), (Y_{t+k} - \hat{Y}_{t+k})]}{\sqrt{\text{Var}(Y_t - \hat{Y}_t)}\sqrt{\text{Var}(Y_{t+k} - \hat{Y}_{t+k})}} \tag{2.24}$$

where:

$\hat{Y}_t = \beta_1 Y_{t+1} + \beta_2 Y_{t+2} + \ldots + \beta_k Y_{t+k-1}$

$\hat{Y}_{t+k} = \alpha_1 Y_{t+k-1} + \alpha_2 Y_{t+k-2} + \ldots + \alpha_{k-1} Y_{t+1}$

β and α are coefficients of linear regression (Wei, 2006, p. 13). The sample partial autocorrelation function is (Wei, 2006, p. 22):

$$\hat{\phi}_{k+1,k+1} = \frac{\hat{\rho}_{k+1} - \sum_{j=1}^{k}\hat{\phi}_{kj}\hat{\rho}_{k+1-j}}{1 - \sum_{j=1}^{k}\hat{\phi}_{kj}\hat{\rho}_j} \tag{2.25}$$

and

$$\hat{\phi}_{k+1,j} = \hat{\phi}_{kj} - \hat{\phi}_{k+1,k+1}\hat{\phi}_{k,k+1-j}, \quad j = 1, 2, \ldots, k. \tag{2.26}$$

The general behavior of the autocorrelation and partial autocorrelation functions for specifying simple ARMA order is summarized in Table 2.1 (Cryer & Chan, 2008, p. 116).

Table 2.1 General Behavior of ACF and PACF for ARMA Order

	AR(p)	MA(q)	ARMA(p,q)
ACF	Tails off	Cuts off after lag q	Tails off
PACF	Cuts off after lag p	Tails off	Tails off

2.4.2 Conditional Least Squares (CLS) Estimation

Parameters of ARIMAX model can be estimated by using conditional least squares (CLS) method. In this method, a possibly nonzero mean, μ, is treated as another parameter to be estimated in stationary models.

2.4.2.1 Conditional Least Squares Estimation for Autoregressive Model

Consider the AR(1) model where

$$\begin{aligned} Y_t - \mu_0 &= \phi(Y_{t-1} - \mu_0) + a_t \\ a_t &= (Y_t - \mu_0) - \phi(Y_{t-1} - \mu_0). \end{aligned} \tag{2.27}$$

Since there are n observations, the error can be summed only from t = 2 to t = n. The conditional sum of squares function is (Cryer & Chan, 2008, p. 154):

$$S_c(\phi, \mu_0) = \sum_{t=2}^{n} \left[(Y_t - \mu_0) - \phi(Y_{t-1} - \mu_0) \right]^2. \tag{2.28}$$

The μ_0 and ϕ are estimated by the respective values that minimize $S_c(\phi, \mu_0)$ given the observed values of Y_1, Y_2,..., Y_n. The minimization for solving μ_0 is

$$\frac{\partial S_c(\phi, \mu_0)}{\partial \mu_0} = \sum_{t=2}^{n} 2\left[(Y_t - \mu_0) - \phi(Y_{t-1} - \mu_0) \right](-1 + \phi) = 0 \tag{2.29}$$

The solution for μ_0 is

$$\mu_0 = \frac{1}{(n-1)(1-\phi)} \left[\sum_{t=2}^{n} Y_t - \phi \sum_{t=2}^{n} Y_{t-1} \right]. \tag{2.30}$$

For large n,

$$\frac{1}{n-1} \sum_{t=2}^{n} Y_t \approx \frac{1}{n-1} \sum_{t=2}^{n} Y_{t-1} \approx \bar{Y}$$

Thus, regardless of the ϕ value, Equation (2.29) reduces to

$$\hat{\mu}_0 = \frac{1}{1-\phi} \left[\bar{Y} - \phi \bar{Y} \right] = \bar{Y} \tag{2.31}$$

This result is similar for the general AR(p) process (Cryer & Chan, 2008, p. 155).

The minimization for solving ϕ is

$$\frac{\partial S_c(\phi, \bar{Y})}{\partial \phi} = \sum_{t=2}^{n} 2\left[(Y_t - \bar{Y}) - \phi(Y_{t-1} - \bar{Y}) \right](Y_{t-1} - \bar{Y}) = 0 \tag{2.32}$$

thus the solution for ϕ is

$$\hat{\phi} = \frac{\sum_{t=2}^{n}(Y_t - \overline{Y})(Y_{t-1} - \overline{Y})}{\sum_{t=2}^{n}(Y_{t-1} - \overline{Y})^2} \tag{2.33}$$

To generalize the estimation of ϕ's, the AR(2) model is considered. In the conditional sum of squares function, μ is replaced by $\overline{Y}$, thus

$$S_c(\phi_1, \phi_2, \overline{Y}) = \sum_{t=3}^{n}\left[(Y_t - \overline{Y}) - \phi_1(Y_{t-1} - \overline{Y}) - \phi_2(Y_{t-2} - \overline{Y})\right]^2. \tag{2.34}$$

The minimization is

$$\frac{\partial S_c}{\partial \phi_1} = -2\sum_{t=3}^{n}\left[(Y_t - \overline{Y}) - \phi_1(Y_{t-1} - \overline{Y}) - \phi_2(Y_{t-2} - \overline{Y})\right](Y_{t-1} - \overline{Y}) = 0 \tag{2.35}$$

which can be written as

$$\begin{aligned}\sum_{t=3}^{n}(Y_t - \overline{Y})(Y_{t-1} - \overline{Y}) = &\left(\sum_{t=3}^{n}(Y_{t-1} - \overline{Y})^2\right)\phi_1 \\ &+\left(\sum_{t=3}^{n}(Y_{t-1} - \overline{Y})(Y_{t-2} - \overline{Y})\right)\phi_2\end{aligned} \tag{2.36}$$

If both sides of Equation (2.35) are divided by $\sum_{t=3}^{n}(Y_t - \overline{Y})^2$, then, except for end effects, which are negligible under the stationarity assumption,

$$r_1 = \phi_1 + r_1\phi_2. \tag{2.37}$$

The similar way for equation $\partial S_c / \partial \phi_2 = 0$ leads to

$$r_2 = r_1\phi_1 + \phi_2. \tag{2.38}$$

Equation (2.36) and (2.37) are the sample Yule-Walker equations for AR(2) model. For the general stationary AR(p) model, the conditional least squares estimates of ϕ's are obtained by solving the sample Yule-Walker equations (Cryer & Chan, 2008, p. 156).

2.4.2.2 Conditional Least Squares Estimation for Moving Average Model

Consider the MA(1) model where

$$Y_t = a_t - \theta a_{t-1} \tag{2.39}$$

The invertible MA(1) models can be expressed as an autoregressive model with infinite order, that

$$Y_t = -\theta Y_{t-1} - \theta^2 Y_{t-2} - \theta^3 Y_{t-3} - ... + a_t.$$

Thus, the conditional least squares can be applied by choosing a value of θ that minimizes

$$S_c(\theta) = \sum_t a_t^2 = \sum_t \left[Y_t + \theta Y_{t-1} + \theta^2 Y_{t-2} + \theta^3 Y_{t-3} + ... \right]^2 \tag{2.40}$$

where $a_t = a_t(\theta)$ is a function of the series and the unknown parameter θ. For the general MA(q) models, a numerical optimization algorithm is needed (Cryer & Chan, 2008, p. 157).

2.4.2.3 Conditional Least Squares Estimation for Mixed Model

Consider the ARMA(1,1) model

$$\begin{aligned} Y_t &= \phi Y_{t-1} + a_t - \theta a_{t-1} \\ a_t &= Y_t - \phi Y_{t-1} + \theta a_{t-1} \end{aligned} \tag{2.41}$$

The parameters are estimated by minimizing

$$S_c(\phi, \theta) = \sum_{t=2}^{n} a_t^2$$

For the general ARMA(p,q) model,

$$\begin{aligned} a_t = Y_t - \phi_1 Y_{t-1} - \phi_2 Y_{t-2} - ... - \phi_p Y_{t-p} \\ + \theta_1 a_{t-1} + \theta_2 a_{t-2} + ... + \theta_q a_{t-q} \end{aligned} \tag{2.42}$$

with $a_p = a_{p-1} = ... = a_{p+1-q} = 0.$ All the parameters can be obtained by minimizing $S_c(\phi_1, \phi_2, ..., \phi_p, \theta_1, \theta_2, ..., \theta_q)$ numerically (Cryer & Chan, 2008, p. 158).

2.4.3 Assumptions in ARIMAX Model

ARIMAX models assume that the residual is independent and follows Normal distribution. Independent means that the residual at time t is not correlated with residual at time (t-k) where $k = 1, 2, 3, ...$. The white noise condition can be examined by Ljung-Box test with hypothesis

H_0 : $\rho_1 = \rho_2 = ... = \rho_K = 0$

H_1 : at least a $\rho_k \neq 0$ where k = 1, 2,..., K.

The statistic test is

$$Q_K = n(n+2)\sum_{k=1}^{K} \frac{\hat{\rho}_k^2}{(n-k)}. \tag{2.43}$$

H_0 is rejected if Q_K is greater than $\chi^2_{\alpha;K-p-q}$ or p-value is less than α.

The normality of residual can be examined by using Kolmogorov-Smirnov test with hypothesis

$H_0 : F_n(a_t) = F_0(a_t)$

$H_1 : F_n(a_t) \neq F_0(a_t)$.

The statistic test is

$$D = \sup_{a_t} \left| F_n(a_t) - F_0(a_t) \right|. \tag{2.44}$$

where $F_n(a_t)$ is the cummulative distribution of the residual and $F_0(a_t)$ is the cummulative distribution of Normal distribution. H_0 is rejected if D is larger than $D_{(1-\alpha,n)}$, or p-value is less than α.

2.5 Time Series Outliers

Time series observations are sometimes influenced by interruptive events. These interruptions make the observations inconsistent with the rest of the series. Such observations are named as outliers. The presence of outliers can makes unreliable and invalid analysis, such as misidentification of ARMA order and violation of normality assumption. In practice, the interruptive events are sometimes unknown, so the outlier detection procedures are needed.

The characteristic of outliers can be additive, innovative, level shift or temporary change. Considering X_t follows a general ARMA(p,q) model, an additive outlier (AO) model is defined as (Wei, 2006, p. 223):

$$\begin{aligned} Y_t &= \begin{cases} X_t, & t = T \\ X_t + \omega, & t \neq T \end{cases} \\ &= X_t + \omega I_t^{(T)} \\ &= \frac{\theta_q(B)}{\phi_p(B)} a_t + \omega I_t^{(T)} \end{aligned} \tag{2.45}$$

where

$$I_t^{(T)} = \begin{cases} 1, & t = T \\ 0, & t \neq T \end{cases}$$

is the indicator variable representing the presence of outlier at time *T*. An innovational outlier (IO) model is defined as (Wei, 2006, p. 224):

$$\begin{aligned} Y_t &= X_t + \frac{\theta_q(B)}{\phi_p(B)} \omega I_t^{(T)} \\ &= \frac{\theta_q(B)}{\phi_p(B)} \left(a_t + \omega I_t^{(T)} \right). \end{aligned} \tag{2.46}$$

The level shift (LS) outlier model is

$$Y_t = X_t + \frac{1}{(1-B)} \omega I_t^{(T)} \tag{2.47}$$

and the temporary change (TC) outlier model is

$$Y_t = X_t + \frac{1}{(1-\delta B)} \omega I_t^{(T)} \tag{2.48}$$

where X_t is the underlying outlier-free process (Wei, 2006, p. 230). Hence, an additive outlier affects only Y_T, whereas an innovational, level shift and temporary change outlier affects all observations beyond time *T*.

2.6 Artificial Neural Networks (ANN)

Artificial neural networks (ANN) are computing models for information processing and pattern identification (Zhang, 2003). The most widely and successfully used neural networks is feedforward neural network. It also known as multilayer perceptron. It consists of neurons that form some layers, i.e. input layer, hidden layer and output layer. Figure 2 shows the general architecture of feedforward neural network.

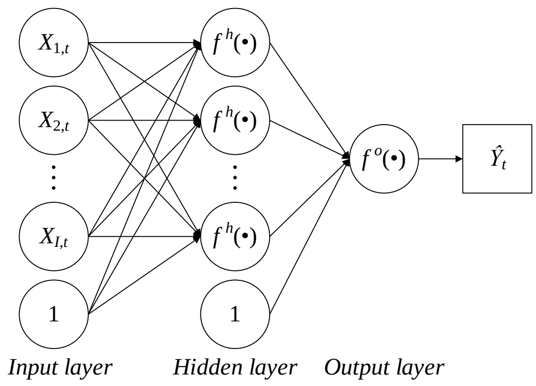

Figure 2.2 Architecture of feedforward neural network.

The mathematical model of artificial neural networks is:

$$\hat{Y}_t = f^o\left[\beta_0 + \sum_{j=1}^{J}\left(\beta_j f^h\left(\gamma_{j0} + \sum_{i=1}^{I}\gamma_{ji}X_{i,t}\right)\right)\right] \tag{2.49}$$

where β_j is weight of the j-th neuron in hidden layer, γ_{ji} is weight from i-th input to j-th neuron in hidden layer, $f^h(\bullet)$ is the activation function in hidden layer, and $f^o(\bullet)$ is the activation function in output layer. The activation function in output layer can be linear function, while the hidden layer can use hyperbolic tangent function, which is:

$$f^h(x) = \frac{e^x - e^{-x}}{e^x + e^{-x}} = \frac{e^{2x} - 1}{e^{2x} + 1} = \frac{1 + e^{-2x}}{1 - e^{-2x}}. \tag{2.50}$$

This function yields values ranged from -1 to 1 as shown in Figure 2.3.

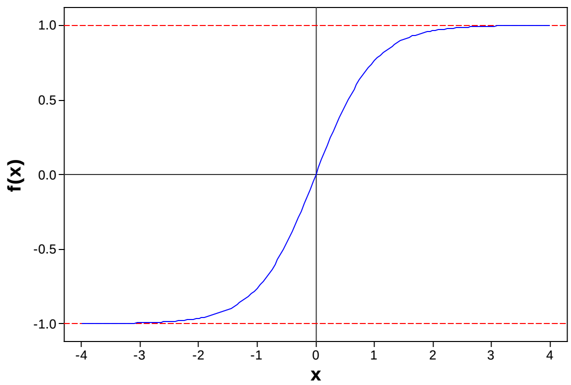

Figure 2.3 Hyperbolic tangent function.

The parameters of ANN are called weights, which are usually estimated by a supervised learning algorithm. This learning algorithm use a given output that is compared to the predicted output. All parameters are adapted according to this comparison. The following steps are repeated during the training process:

1. The ANN calculates the predicted output $\hat{Y}$ based on given inputs X and current weights.
2. The difference between predicted and observed output is measured by an error function:

$$E = \frac{1}{2}\sum_{t=1}^{n}[Y_t - \hat{Y}_t]^2. \tag{2.51}$$

3. All weights are adapted according to the rule of a learning algorithm.

The process stops if a pre-specified criterion is fulfilled.

A widely used learning algorithm is the backpropagation and resilient backpropagation algorithm. The traditional backpropagation modifies the weights of a neural network in order to find a local minimum of the error function. The weights are adjusted by the following rule

$$w^{(k+1)} = w^{(k)} - \eta \frac{\partial E^{(k)}}{\partial w^{(k)}} \tag{2.52}$$

where w is the weight, k indexes the iteration steps and η is the learning rate. The problem is specifying the proper learning rate. The resilient backpropagation algorithm can solve this problem by using learning rate that can be changed during the training process. The rule of resilient backpropagation is

$$w^{(k+1)} = w^{(k)} - \eta^{(k)} \cdot \mathrm{sign}\left(\frac{\partial E^{(k)}}{\partial w^{(k)}}\right) \tag{2.53}$$

A globally convergent version of resilient backpropagation has been introduced by Anastasiadis, Magoulas, and Vrahatis (2005). This method modifies a learning rate in relation to all other learning rates by the following rule

$$\eta_i^{(k)} = -\frac{\sum_{j;j\neq i} \eta_j^{(k)} \cdot \frac{\partial E^{(k)}}{\partial w_j^{(k)}} + \delta}{\frac{\partial E^{(k)}}{\partial w_i^{(k)}}} \tag{2.54}$$

where i indexes either the learning rate associated with the smallest absolute partial derivative or the smallest learning rate, and $0 < \delta \leq \infty$.

The followings are the partial derivatives of the error function for each weights of neural network

$$\frac{\partial E}{\partial \beta_j} = -\sum_{t=1}^{n} \delta_{(t)}^{o} V_{j(t)} \tag{2.55}$$

$$\frac{\partial E}{\partial \beta_0} = -\sum_{t=1}^{n} \delta_{(t)}^{o} \tag{2.56}$$

$$\frac{\partial E}{\gamma_{ji}} = -\sum_{t=1}^{n} \delta_{(t)}^{h} X_{i(t)} \tag{2.57}$$

$$\frac{\partial E}{\gamma_{jo}} = -\sum_{k=1}^{n} \delta_{(k)}^{h} \tag{2.58}$$

where

$$\delta_{(t)}^{o} = \left[Y_{(t)} - \hat{Y}_{(t)} \right] f^{o} \left(\beta_0 + \sum_{l=1}^{n} \beta_l V_{l(t)} \right)$$

$$\delta_{(t)}^{h} = \delta_{(t)}^{o} \beta_j f^{h} \left(\gamma_{lo} + \sum_{l=1}^{q} \gamma_{li} X_{i(t)} \right).$$

2.7 Hybrid Model

Both ARIMA and ARIMAX are linear model, so it cannot handle nonlinear autocorrelation structure of data. However, it is easy to interpret. On the other hand, ANN is a powerful nonlinear model but not interpretable. The idea of hybrid modeling is to deliver an interpretable model that can yields accurate forecast by combining linear and nonlinear model. A time series is considered composed of a linear autocorrelation structure and a nonlinear component. The structure is

$$Y_t = L_t + N_t \tag{2.59}$$

where L_t is the linear component, N_t is the nonlinear component (Zhang, 2003).

The model estimation is done in two steps. First, the linear component is modeled, so the residuals will contain only the nonlinear relationship. Let a_t denote the residual at time t from the linear model, then

$$a_t = Y_t - \hat{L}_t \tag{2.60}$$

where $\hat{L}_t$ is the fitted value of linear model at time t. The second step is to model a_t by using ANN. The ANN model for the residual is

$$\begin{aligned} a_t &= f(a_{t-1}, a_{t-2}, \ldots, a_{t-k}) + e_t \\ &= \hat{N}_t + e_t \end{aligned} \tag{2.61}$$

where f is a nonlinear function determined by ANN and $\hat{N}_t$ is the fitted value of ANN at time t. Thus, the hybrid ARIMAX-ANN model is

$$Y_t = \hat{L}_t + \hat{N}_t + e_t \tag{2.62}$$

2.8 Forecast Interval Based on Minimum Mean Square Error

Consider an ARIMA model when $d = 0$ and $\mu_0 = 0$, i.e.

$$Y_t = \frac{\theta_q(B)}{\phi_p(B)} a_t. \tag{2.63}$$

Because the model is stationary, it can be rewritten in a moving average representation,

$$\begin{aligned} Y_t &= \psi(B) a_t \\ &= (1 + \psi_1 B + \psi_2 B^2 + \ldots) a_t \\ &= a_t + \psi_1 a_{t-1} + \psi_2 a_{t-2} + \ldots \end{aligned} \tag{2.64}$$

thus

$$\psi(B) = \sum_{j=0}^{\infty} \psi_j B^j = \frac{\theta_q(B)}{\phi_p(B)} \tag{2.65}$$

where $\psi_0 = 1$ (Wei, 2006). For $t = n + l$,

$$Y_{n+l} = \sum_{j=0}^{\infty} \psi_j a_{n+l-j}\ . \tag{2.66}$$

Suppose that the observations $Y_n, Y_{n-1}, Y_{n-2}, \ldots$ are used to forecast l-step ahead of future value Y_{n+l}. Because Y_t for $t = n, (n-1), (n-2), \ldots$ can all be written in the form of (2.64), the minimum mean square error forecast of Y_{n+l} is

$$\hat{Y}_n(l) = \psi_l^* a_n + \psi_{l+1}^* a_{n-1} + \psi_{l+2}^* a_{n-2} + \ldots. \tag{2.67}$$

The mean square error of the forecast is

$$E(Y_{n+l} - \hat{Y}_n(l))^2 = \sigma_a^2 \sum_{j=0}^{l-1} \psi_j^2 + \sigma_a^2 \sum_{j=0}^{\infty} \left[\psi_{l+j} - \psi_{l+j}^* \right]^2 \tag{2.68}$$

which is minimized when $\psi_{l+j}^* = \psi_{l+j}$. Hence,

$$\hat{Y}_n(l) = \psi_l a_n + \psi_{l+1} a_{n-1} + \psi_{l+2} a_{n-2} + \dots \qquad (2.69)$$

Using (2.66) and

$$E(a_{n+j} \mid Y_n, Y_{n-1}, \dots) = \begin{cases} 0, & j > 0 \\ a_{n+j}, & j \le 0 \end{cases} \qquad (2.70)$$

obtained that

$$E(Y_{n+l} \mid Y_n, Y_{n-1}, \dots) = \psi_l a_n + \psi_{l+1} a_{n-1} + \psi_{l+2} a_{n-2} + \dots \qquad (2.71)$$

Thus, the minimum mean square error forecast of Y_{n+l} is given by its conditional expectation that is

$$\hat{Y}_n(l) = E(Y_{n+l} \mid Y_n, Y_{n-1}, \dots). \qquad (2.72)$$

The forecast error is

$$e_n(l) = Y_{n+l} - \hat{Y}_n(l) = \sum_{j=0}^{l-1} \psi_j a_{n+l-j}. \qquad (2.73)$$

Because $E(e_n(l) \mid Y_t, t \le n) = 0,$ the forecast is unbiased with the error variance (Wei, 2006):

$$\mathrm{Var}(e_n(l)) = \sigma_a^2 \sum_{j=0}^{l-1} \psi_j. \qquad (2.74)$$

For a normal process, the (1 – α) 100% forecast limits are (Wei, 2006)

$$\hat{Y}_n(l) \pm N_{\alpha/2} \sqrt{\mathrm{Var}(e_n(l))}. \qquad (2.75)$$

2.9 Forecast Interval based on GARCH Model

The (1 – α) 100% forecast limits in Equation (2.75) has a homoscedasticity assumption or a constant error variance. If the assumption is violated, the interval can be based on conditional variance forecast by using generalized autoregressive conditional heteroscedasticity (GARCH) model. According to Engle (1982) in Wei (2006, p. 368), the error term of mean model can be modeled as

$$n_t = \sigma_t e_t \qquad (2.76)$$

where e_t is random variable with mean 0 and variance 1, and

$$\sigma_t^2 = \theta_0 + \theta_1 n_{t-1}^2 + \theta_2 n_{t-2}^2 + \dots + \theta_s n_{t-s}^2. \qquad (2.77)$$

The conditional variance of n_t is

$$\begin{aligned}\mathrm{Var}_{t-1}(n_t) &= \mathrm{E}_{t-1}(n_t^2) \\ &= \mathrm{E}(n_t^2 \mid n_{t-1}, n_{t-2}, \ldots) \\ &= \sigma_t^2 \\ &= \theta_0 + \theta_1 n_{t-1}^2 + \theta_2 n_{t-2}^2 + \ldots + \theta_s n_{t-s}^2 .\end{aligned} \tag{2.78}$$

Equation (2.77) is the forecast of a_t that follows the following AR(s) model

$$n_t^2 = \theta_0 + \theta_1 n_{t-1}^2 + \theta_2 n_{t-2}^2 + \ldots + \theta_s n_{t-s}^2 + a_t \tag{2.79}$$

where a_t is an $N(0, \sigma_a^2)$ white noise process. The model of n_t specified by Equation (2.76), (2.77) or (2.79) is the autoregressive conditional heteroscedasticity (ARCH) with order s, denoted as ARCH(s).

Generalized autoregressive conditional heteroscedasticity (GARCH) is the more general process. It considers that the conditional variance is related to not only the past squared errors but also the past conditional variance. As proposed by Bollerslev (1986) (Bollerslev, 1986), GARCH(r,s) model is specified by (Wei, 2006, p. 370):

$$\sigma_t^2 = \theta_0 + \phi_1 \sigma_{t-1}^2 + \ldots + \phi_r \sigma_{t-r}^2 + \theta_1 n_{t-1}^2 + \ldots + \theta_s n_{t-s}^2 . \tag{2.80}$$

Equation (2.66) is not a proper ARMA(r,s) model because neither n_t^2 or σ_t^2 plays the proper role. By considering $a_t = (n_t^2 - \sigma_t^2)$, Equation (2.80) can be rewritten in terms of n_t^2 and a_t as follows:

$$n_t^2 = \theta_0 + \sum_{i=1}^{m} (\phi_i + \theta_i) n_{t-i}^2 + a_t - \sum_{j=1}^{r} \phi_j a_{t-j} \tag{2.81}$$

or

$$n_t^2 = \frac{\theta_0 + (1 - \phi_1 B - \ldots - \phi_r B^r) a_t}{(1 - \alpha_1 B - \ldots - \alpha_m B^m)} \tag{2.82}$$

where $m = \max(r,s)$, $\phi_i = 0$ for $i > r$, $\theta_i = 0$ for $i > s$, and $\alpha_i = (\phi_i + \theta_i)$. Equation (2.82) is a proper ARMA(m,r) model because $E_{t-1}(n_t^2) = \sigma_t^2$, σ_t^2 is the one step ahead forecast of n_t^2, and a_t is the corresponding error. Thus, GARCH(r,s) model in Equation (2.80) follows ARMA(m,r) in Equation (2.82) (Wei, 2006, p. 371).

The orders r and s of GARCH model can be identified by using the similar techniques as identifying the ARMA orders. To test the presence of GARCH order, the conditional mean needs to be modeled first to obtain the residual n_t. Then the portmanteau test can be applied under the following hypothesis

H_0: $\rho_k(n_t^2) = 0$

H_1: at least a $\rho_k(n_t^2) \neq 0,\ k = 1, 2, ..., K$

The statistic test is

$$Q_K = n(n+2)\sum_{k=1}^{K}\frac{\hat{\rho}_k^2(\hat{n}_t^2)}{(n-k)}. \tag{2.83}$$

where $\hat{\rho}_k(n_t^2)$ is the sample autocorrelation of n_t^2 at lag k. H_0 is rejected if Q_K is greater than $\chi^2_{\alpha;K}$ or p-value is less than α. The significance of Q_K for small value of k indicates an ARCH model, and persistent significance for large k indicates GARCH model (Wei, 2006, p. 373).

2.10 Currency Circulation in Bank Indonesia

Payment is related to the transfer of funds from a party to another party that utilize instrument of payment. Instrument of payment can be cash or non-cash. In the field of cash payment system, Bank Indonesia is the only institution authorized to issue, circulate, revoke and withdraw Rupiah currency, and destroy money from circulation in Indonesia. In order to implement its authority in cash payment, Bank Indonesia has mission to satisfy the needs of currency in the community in terms of sufficient amount, appropriate nominations, timely and feasible condition. To achieve its mission formulates strategic activities in currency circulation as follows (Pramono, Yanuarti, Purusitawati, & Emmy, 2006, p. 10):

1. The release of new money must be based on a research and planning, so the new money has good quality. Research and planning are carried out to establish drawing design, material, security element, and printing techniques of money, as well as the compatibility with sorting machines and ATM.
2. Policies that ensure the stock of money in sufficient quantities with various fractions to satisfy the withdrawals and supply of money. This policy must be supported by accurate printing plans, distribution feasibility policy that can be tolerated, and adequate distribution system.

3. Having effective money distribution system to ensure the availability of sufficient, smooth and timely stock of money. This can be realized if there is an accurate plan for the distribution of money, smooth transportation, and effective cash warehouses in carrying out their functions.
4. The existence of policies that encourage the involvement of banks and other agencies in assisting the circulation of money by Bank Indonesia.

The management of currency circulation can involves some groups of data, such as currency inflow, outflow and net-flow. Those indicators are described as follows (Bank Indonesia, 2016a):

1. Rupiah deposits (inflow) refers to information about the flow of banknotes and coins into Bank Indonesia from banks and the public, in the form of commercial bank deposits, nonbank deposits, mobile cash for exchange purposes, deposits through cash custodians at commercial banks, and other deposits.
2. Rupiah withdrawals (outflow) refers to information about the flow of banknotes and coins out of Bank Indonesia to banks and the public, in the form of commercial bank withdrawals, nonbank withdrawals, mobile cash for exchange purposes, withdrawals through cash custodians at commercial banks, and other withdrawals.
3. Net Withdrawal/Deposit transactions (net-flow) in Rupiah refer to the difference between the value of deposits in Rupiah (inflow) and the value of withdrawals in Rupiah (outflow). A Net Inflow of currency means that the amount of currency deposited in Bank Indonesia is larger than the amount of currency withdrawn from Bank Indonesia. Meanwhile, a Net Outflow of currency means that the amount of currency deposited in Bank Indonesia (inflow) is smaller than the amount of currency withdrawn from Bank Indonesia (outflow).

There are 44 branch offices of Bank Indonesia, but only 40 of them record the currency circulation. According to Bank Indonesia (2016b), the currency inflow and outflow in those branch offices are aggregated based on corresponding islands as shown on Figure 2.4, and then fully aggregated to national inflow and outflow. Therefore, the inflow and outflow data have a hierarchical structure as shown on Figure 2.5.

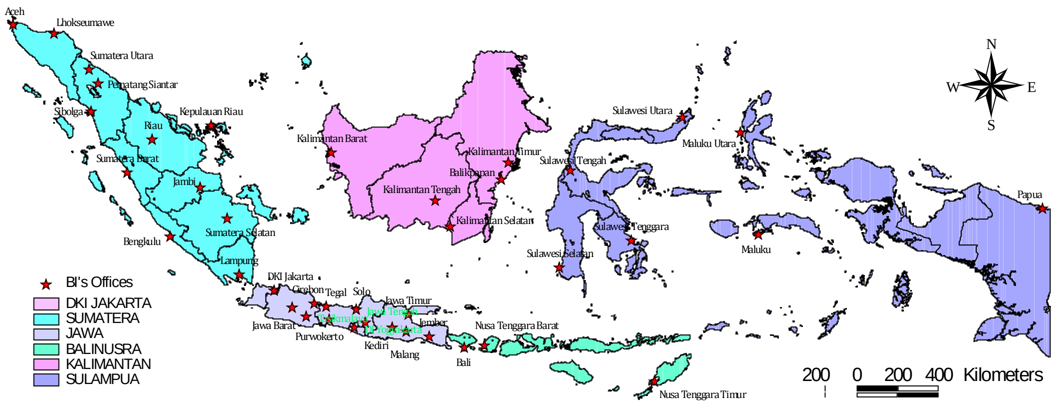

Figure 2.4 Location of Bank Indonesia's branch offices.

National

DKI Jakarta	Sumatera	Jawa	Balinusra	Kalimantan	Sulampua
- DKI Jakarta	- Aceh	- Jawa Barat	- Bali	- Kalimantan Selatan	- Sulawesi Selatan
	- Lhokseumawe	- Tasikmalaya	- Nusa Tenggara Barat	- Kalimantan Barat	- Sulawesi Tengah
	- Sumatera Utara	- Cirebon	- Nusa Tenggara Timur	- Kalimantan Timur	- Sulawesi Utara
	- Sibolga	- Jawa Tengah		- Kalimantan Tengah	- Sulawesi Tenggara
	- Pematang Siantar	- DI Yogyakarta		- Balikpapan	- Maluku
	- Bengkulu	- Solo			- Maluku Utara
	- Jambi	- Purwokerto			- Papua
	- Sumatera Barat	- Tegal			
	- Riau	- Jawa Timur			
	- Kepulauan Riau	- Malang			
	- Sumatera Selatan	- Kediri			
	- Lampung	- Jember			

Figure 2.5 Hierarchical structure of currency inflow and outflow in Bank Indonesia.

CHAPTER III
METHODOLOGY

This chapter contains the explanation about data, variables, and steps of analysis including ARIMAX modeling, hybrid ARIMAX-ANN modeling, hierarchical forecasting and interval forecasting.

3.1 Data and Variables

The data used in this study are secondary data obtained from Bank Indonesia. The data are monthly currency inflow and outflow, which have two level hierarchical structure (K=2). The "level 2" series are the inflow and outflow at each branch offices of Bank Indonesia. The "level 1" series are the aggregation of "level 2" series based on islands, and the "level 0" series are the most aggregated data or the national inflow and outflow. All series are divided into in-sample and out-of-sample data. The in-sample data are from January 2003 until December 2013, and the out-of-sample data are from January until December 2014.

In the modeling, the inflow and outflow series are treated as univariate independent variable with the following notations:

$Y_{i,t}^{\text{in}}$ = currency inflow for series i at period t

$Y_{i,t}^{\text{out}}$ = currency outflow for series i at period t.

The modeling also involves dependent variables to capture the calendar variation effect of Eid al-Fitr by using the following dummy variables:

$$H_{j,t} = \begin{cases} 1, & \text{if there is an Eid al-Fitr at period } t \\ 0, & \text{others} \end{cases}$$

$H_{j,t-1}$ to explain the effect for a month after Eid, and $H_{j,t+1}$ to explain the effect for a month before Eid, where j $(j = 0,1,\ldots,30)$ is the number of days before Eid in corresponding month. The structure of the data can be seen on Table 3.1 and 3.2, and the information about the occurrences of Eid al-Fitr are shown on Table 3.3.

Table 3.1 Structure of Currency Inflow Data

Level	i	Series	Inflow				Number of series
0	1	National	$Y_{1,1}^{\text{in}}$	$Y_{1,2}^{\text{in}}$	$\cdots$	$Y_{1,144}^{\text{in}}$	1
1	2	DKI Jakarta	$Y_{2,1}^{\text{in}}$	$Y_{2,2}^{\text{in}}$	$\cdots$	$Y_{2,144}^{\text{in}}$	6
	3	Sumatera	$Y_{3,1}^{\text{in}}$	$Y_{3,2}^{\text{in}}$	$\cdots$	$Y_{3,144}^{\text{in}}$	
	$\vdots$	$\vdots$	$\vdots$	$\vdots$		$\vdots$	
	7	Sulampua	$Y_{7,1}^{\text{in}}$	$Y_{7,2}^{\text{in}}$	$\cdots$	$Y_{7,144}^{\text{in}}$	
2	8	DKI Jakarta	$Y_{8,1}^{\text{in}}$	$Y_{8,2}^{\text{in}}$	$\cdots$	$Y_{8,144}^{\text{in}}$	40
	9	Aceh	$Y_{9,1}^{\text{in}}$	$Y_{9,2}^{\text{in}}$	$\cdots$	$Y_{9,144}^{\text{in}}$	
	$\vdots$	$\vdots$	$\vdots$	$\vdots$		$\vdots$	
	47	Papua	$Y_{46,1}^{\text{in}}$	$Y_{46,2}^{\text{in}}$	$\cdots$	$Y_{46,144}^{\text{in}}$	

Table 3.2 Structure of Currency Outflow Data

Level	i	Series	Outflow				Number of series
0	1	National	$Y_{1,1}^{\text{out}}$	$Y_{1,2}^{\text{out}}$	$\cdots$	$Y_{1,144}^{\text{out}}$	1
1	2	DKI Jakarta	$Y_{2,1}^{\text{out}}$	$Y_{2,2}^{\text{out}}$	$\cdots$	$Y_{2,144}^{\text{out}}$	6
	3	Sumatera	$Y_{3,1}^{\text{out}}$	$Y_{3,2}^{\text{out}}$	$\cdots$	$Y_{3,144}^{\text{out}}$	
	$\vdots$	$\vdots$	$\vdots$	$\vdots$		$\vdots$	
	7	Sulampua	$Y_{7,1}^{\text{out}}$	$Y_{7,2}^{\text{out}}$	$\cdots$	$Y_{7,144}^{\text{out}}$	
2	8	DKI Jakarta	$Y_{8,1}^{\text{out}}$	$Y_{8,2}^{\text{out}}$	$\cdots$	$Y_{8,144}^{\text{out}}$	40
	9	Aceh	$Y_{9,1}^{\text{out}}$	$Y_{9,2}^{\text{out}}$	$\cdots$	$Y_{9,144}^{\text{out}}$	
	$\vdots$	$\vdots$	$\vdots$	$\vdots$		$\vdots$	
	47	Papua	$Y_{46,1}^{\text{out}}$	$Y_{46,2}^{\text{out}}$	$\cdots$	$Y_{46,144}^{\text{out}}$	

Table 3.3 The Occurrences of Eid al-Fitr

t	Year	Date		j	Explanation
11	2003	25-26	November	24	There are 24 days before Eid in November
23	2004	14-15	November	13	There are 13 days before Eid in November
35	2005	03-04	November	2	There are 2 days before Eid in November
46	2006	24-25	October	23	There are 23 days before Eid in October
58	2007	13-14	October	12	There are 12 days before Eid in October
70	2008	01-02	October	0	There is no day before Eid in October
81	2009	20-21	September	19	There are 19 days before Eid in September
93	2010	10-11	September	9	There are 9 days before Eid in September
104	2011	31	August	30	There are 30 days before Eid in August
116	2012	19-20	August	18	There are 18 days before Eid in August

Table 3.3 (Extension)

t	Year	Date		j	Explanation
128	2013	08-09	August	7	There are 7 days before Eid in August
139	2014	28-29	July	27	There are 27 days before Eid in July

3.2 Steps of Analysis

In hierarchical forecasting, the base forecasts are required. Therefore, the first step is to forecast all series individually by using the best model between ARIMAX and hybrid ARIMAX-ANN model. The base forecasts are then revised by using the best hierarchical method between top-down, bottom-up and optimal combination. The best model and method are selected based on the out-of-sample root mean squared error (RMSE) with the following formula

$$\text{RMSE} = \sqrt{\frac{1}{L}\sum_{l=1}^{L}(Y_{n+l} - \hat{Y}_n(l))^2} \tag{3.1}$$

where L is the number of out-of-sample, n is the number of in-sample, Y_{n+l} is the actual value at period $(n+l)$, and $\hat{Y}_n(l)$ is the predicted value at period $(n+l)$. The final step is to make forecast intervals for each series based on GARCH model. The GARCH models are also identified after ARIMAX and hybrid modeling. The general steps of analysis of this research are shown on Figure 3.1.

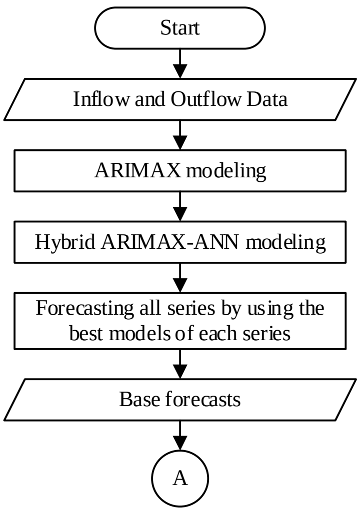

Figure 3.1 Steps of analysis.

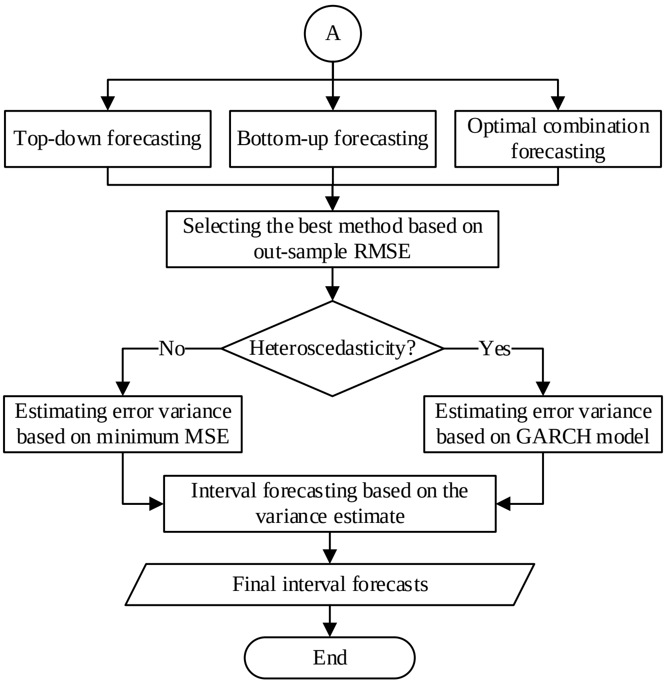

Figure 3.1 (Extension).

3.2.1 ARIMAX Modeling

The two level ARIMAX models are built by following some steps. Firstly, the data are plotted by using time series plot to visually identify the trend and seasonal effect, and determine what months are affected by Eid al-Fitr. Based on the identification, the regression models are specified. For example, if the calendar variation affects the month before, during and after Eid al-Fitr, and the model assumes deterministic effects on both trend and seasonal, then the initial model is:

$$Y_{i,t} = \mu t + \sum_{m=1}^{12} \delta_m M_{m,t} + \sum_{j=0}^{30} \alpha_j H_{j,t+1} + \sum_{j=0}^{30} \beta_j H_{j,t} + \sum_{j=0}^{30} \gamma_j H_{j,t-1} + a_{i,t} \tag{3.2}$$

where $M_{i,t}$ is the dummy variable for deterministic month effect specified by

$$M_{1,t} = \begin{cases} 1, & \text{if period } t \text{ is January} \\ 0, & \text{others} \end{cases}$$

$$\vdots$$

$$M_{12,t} = \begin{cases} 1, & \text{if period } t \text{ is December} \\ 0, & \text{others.} \end{cases}$$

The next step is plotting the ACF and PACF of residuals $a_{i,t}$. If the residual is dependent, then the regression models are added by ARIMA orders based on

ACF and PACF identification until independent residuals are obtained. If the residuals are not normally distributed, then the outlier identification will be done until the residuals are independent and normally distributed. Thus, the ARIMAX models become:

$$
\begin{aligned}
Y_{i,t} = \mu t + \sum_{m=1}^{12}\delta_m M_{m,t} + \sum_{j=0}^{30}\alpha_j H_{j,t+1} + \sum_{j=0}^{30}\beta_j H_{j,t} + \sum_{j=0}^{30}\gamma_j H_{j,t-1} \\
+\sum_T \frac{1}{(1-B)}\upsilon_T S_t^{(T)} + \sum_T \omega_T A_t^{(T)} + \frac{\theta_q(B)}{\phi_p(B)} a_{i,t}
\end{aligned}
\tag{3.3}
$$

where $A_t^{(T)}$ is dummy variable for additive outlier (AO) and $S_t^{(T)}$ is dummy variable for level shift (LS) outlier, specified by:

$$
A_t^{(T)} = \begin{cases} 1, & \text{if there is an additive outlier at period } t \\ 0, & \text{others} \end{cases}
$$

$$
S_t^{(T)} = \begin{cases} 1, & \text{if there is a level shift outlier at period } t \\ 0, & \text{others.} \end{cases}
$$

By using the same procedure, other possible ARIMAX models are model with deterministic trend and stochastic seasonal, i.e.:

$$
\begin{aligned}
Y_{i,t} = \mu t + \sum_{j=0}^{30}\alpha_j H_{j,t+1} + \sum_{j=0}^{30}\beta_j H_{j,t} + \sum_{j=0}^{30}\gamma_j H_{j,t-1} \\
+\sum_T \frac{1}{(1-B)}\upsilon_T S_t^{(T)} + \sum_T \omega_T A_t^{(T)} + \frac{\theta_q(B)\Theta_Q(B^s)}{\phi_p(B)\Phi_P(B^s)(1-B^s)^D} a_{i,t},
\end{aligned}
\tag{3.4}
$$

model with stochastic trend and deterministic seasonal, i.e.:

$$
\begin{aligned}
Y_{i,t} = \sum_{m=1}^{12}\delta_m M_{m,t} + \sum_{j=0}^{30}\alpha_j H_{j,t+1} + \sum_{j=0}^{30}\beta_j H_{j,t} + \sum_{j=0}^{30}\gamma_j H_{j,t-1} \\
+\sum_T \frac{1}{(1-B)}\upsilon_T S_t^{(T)} + \sum_T \omega_T A_t^{(T)} + \frac{\theta_q(B)}{\phi_p(B)(1-B)^d} a_{i,t},
\end{aligned}
\tag{3.5}
$$

or model with stochastic trend and seasonal, i.e.:

$$
\begin{aligned}
Y_{i,t} = \sum_{j=0}^{30}\alpha_j H_{j,t+1} + \sum_{j=0}^{30}\beta_j H_{j,t} + \sum_{j=0}^{30}\gamma_j H_{j,t-1} \\
+\sum_T \frac{1}{(1-B)}\upsilon_T S_t^{(T)} + \sum_T \omega_T A_t^{(T)} + \frac{\theta_q(B)\Theta_Q(B^s)}{\phi_p(B)\Phi_P(B^s)(1-B)^d(1-B^s)^D} a_t.
\end{aligned}
\tag{3.6}
$$

Equation (3.3), (3.4), (3.5) or (3.6) is the first level of two level ARIMAX model. For the limited length of in-sample data, those models only can estimate parameters for several j. In the purpose of forecasting, the value of α_j, β_j and γ_j are required for every possibility of j. Therefore, the second level model are needed. The linear regression model can be applied as follows:

$$\hat{\alpha}_j = \xi_0 + \xi_1 j \tag{3.7}$$

$$\hat{\beta}_j = \psi_0 + \psi_1 j \tag{3.8}$$

$$\hat{\gamma}_j = \zeta_0 + \zeta_1 j \tag{3.9}$$

where the response variables are the estimated coefficients of first level ARIMAX model.

3.2.2 Hybrid ARIMAX-ANN Modeling

The hybrid model used in this research is combining ARIMAX and ANN. After the ARIMAX models are obtained, then the residual of ARIMAX are modeled by ANN. The ANN are modeled with the following steps:

1. Determining the input and output of ANN. The output is the residual a_t from ARIMAX model, and the inputs are the past values of residual, which are limited to lag 3, thus the ANN model will be

$$\begin{aligned} a_t &= f(a_{t-1}, a_{t-2}, a_{t-3}) + e_t \\ &= \hat{N}_t + e_t. \end{aligned} \tag{3.10}$$

2. Determining the activation function of ANN. This research uses hyperbolic tangent function in Equation (2.48).
3. Because the function yields the values ranged from -1 to 1, then the data pre-processing is required. The pre-processing uses the following function:

$$X^* = \frac{2[X - \min(X)]}{[\max(X) - \min(X)]} - 1 \tag{3.11}$$

   where $X = (a_t, a_{t-1}, a_{t-2}, a_{t-3})$.
4. Training the ANN for five different architecture, i.e. ANN with 1 to 5 units in hidden neuron. Each architecture are trained with 500 times repetition.
5. Post-processing the output by using the following function:

$$X = \frac{(X^* + 1)[\max(X) - \min(X)]}{2} + \min(X) \tag{3.12}$$

6. Selecting the best architecture of ANN based on the minimum value of out-of-sample RMSE.

The RMSE in step 6 is at once an RMSE of the hybrid ARIMAX-ANN model. Then, the RMSE of hybrid model is compared to the RMSE of ARIMAX model. If the hybrid treatment does not give better result, then the series are forecasted by using ARIMAX model alone. Otherwise, the series are forecasted by using hybrid ARIMAX-ANN model with the following model:

$$Y_t = \hat{L}_t + \hat{N}_t + e_t \tag{3.13}$$

where $\hat{L}_t$ is the forecast by ARIMAX and $\hat{N}_t$ is the forecast by ANN.

3.2.3 Hierarchical Forecasting

At this stage, three hierarchical methods are compared, including top-down, bottom-up and optimal combination. The comparison uses the following steps:

1. Preparing the matrix of base forecasts $\hat{\boldsymbol{Y}}_n(l)$ based on the best hybrid ARIMAX-ANN model.
2. Defining the summing matrix $\boldsymbol{S}$ that satisfies equation $\boldsymbol{Y}_t = \boldsymbol{S}\boldsymbol{Y}_{K,t}$.
3. Obtaining the proportion matrix $\boldsymbol{P}$ for each hierarchical method, i.e., top-down, bottom-up and optimal combination.
4. Revising the base forecasts by using equation $\tilde{\boldsymbol{Y}}_n(l) = \boldsymbol{S}\boldsymbol{P}\hat{\boldsymbol{Y}}_n(l)$ for each method.
5. Selecting the best method by comparing the out-of-sample RMSE of top-down, bottom-up and optimal combination method.

3.2.4 Interval Forecasting for Series with Homoscedasticity

On the series with heteroscedasticity, the forecast interval only can be constructed based on the minimum MSE of ARIMAX model. The procedure is as follows:

1. Calculating the in-sample MSE of ARIMAX model as the constant variance.
2. Obtaining the formula for estimating ψ_j based on the moving average representation of ARIMAX model.
3. Estimating the error variance.

4. Constructing the confidence limits of the forecast based on the estimate of error variance.

3.2.5 GARCH Modeling

The GARCH models are applied in order to construct the confidence limits of hierarchical forecast. The GARCH effects are identified before and after ARIMAX modeling. The steps of GARCH modeling are described as follows:

1. Testing the heteroscedasticity of the ARIMAX, hybrid ARIMAX-ANN, and hierarchical forecasting residual by using Portmanteau test. The residuals that have heteroscedasticity are denoted by n_t.
2. Plotting the ACF and PACF of n_t^2.
3. Identifying the orders of GARCH based on the ACF and PACF.
4. Estimating the parameters of GARCH model.
5. Forecast the conditional variance of the hierarchical forecasting residual.
6. Constructing the confidence limits of the forecast based on the conditional variance forecast.

CHAPTER IV

RESULTS AND DISCUSSION

This chapter explains the results of the study, such as the data description, the ARIMAX and hybrid ARIMAX-ANN model for currency inflow and outflow, the comparison of hierarchical methods, and the interval forecasts.

4.1 Data Description

Descripting the data is an important part of time series forecasting. In ARIMAX modeling, visual representation of time series can be very useful to determine trend and seasonal order. For example, this section discusses about time series plot and boxplot of currency inflow and outflow at national level. The rest of the other series are generally have similar patterns and the plots can be seen on Appendix 1.

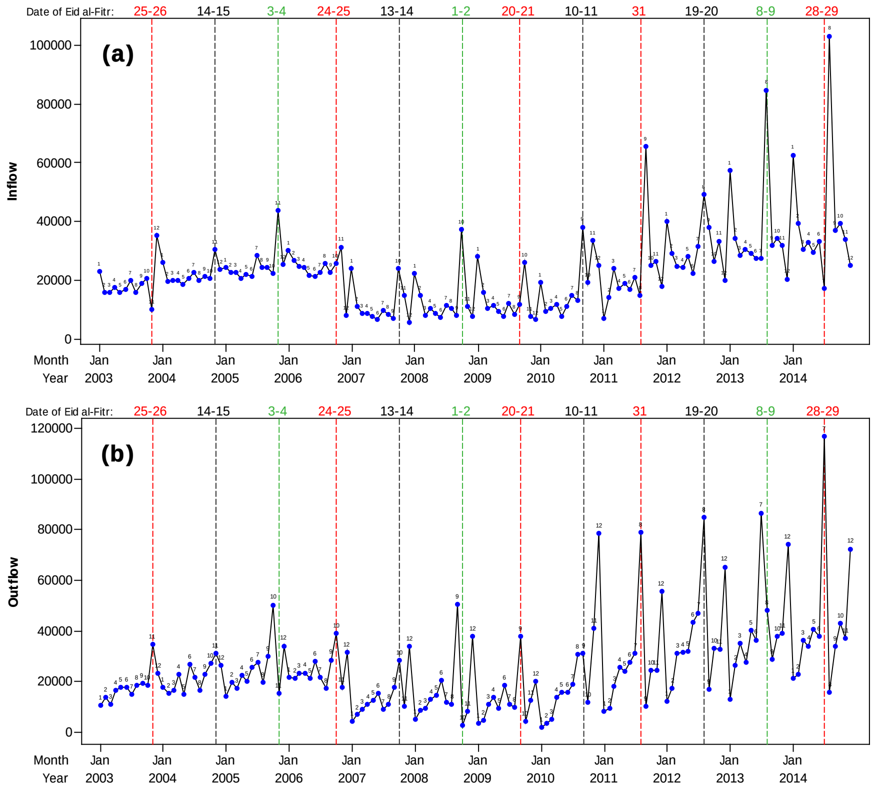

Figure 4.1 Time series plot of national currency (a) inflow and (b) outflow.

Figure 4.1 shows that both currency inflow and outflow has positive trend with level shift at the beginning of 2007. The plot also shows that Eid al-Fitr gives different effect on inflow and outflow data. If the Eid al-Fitr happens in the end of the month, the inflow increase in the next month. Otherwise, the inflow increase in the month containing Eid al-Fitr. If the Eid al-Fitr happens in the End of the month, the outflow increase in that month. Otherwise, the outflow increase in the previous month.

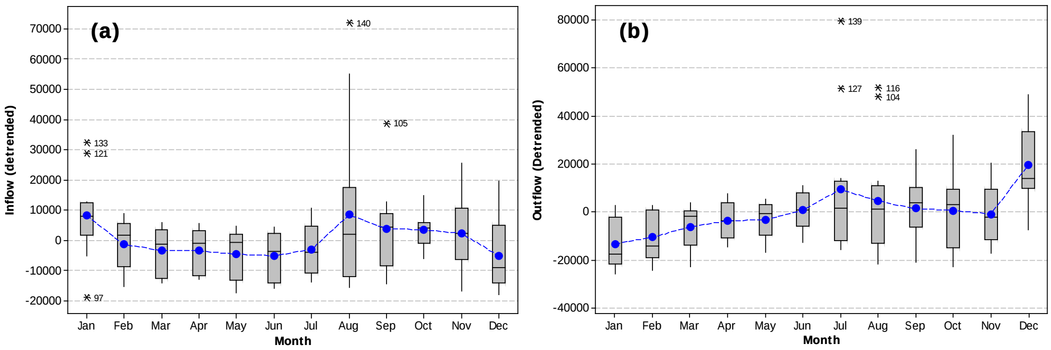

Figure 4.2 Boxplot of national currency (a) inflow and (b) outflow.

The data are also have seasonal patterns as displayed on Figure 4.2. High average amount of inflow occurs in January and August, whereas high amount of outflow occurs in the previous months, which are July and December. Those high currency circulations are caused by the beginning of new academic year in August and celebration of Christmas and New Year in December. Currency circulations in months around January and August also have high variance with several outliers.

4.2 Two Levels ARIMAX Models of Currency Circulation Data

Based on the data description in the previous section, currency inflow data are affected by the presence of Eid al-Fitr in the certain month ($H_{j,t}$) and in the previous month ($H_{j,t-1}$), whereas the outflow data are affected by the presence of Eid al-Fitr in the certain month ($H_{j,t}$) and the in the next month ($H_{j,t+1}$). Therefore, initial model for inflow data is specified as:

$$Y_{i,t} = \mu_1 t + \sum_{j=0}^{30} \beta_j H_{j,t} + \sum_{j=0}^{30} \gamma_j H_{j,t-1} + a_{i,t} \tag{4.1}$$

and the initial model for outflow data is:

$$Y_{i,t} = \mu_1 t + \sum_{j=0}^{30} \alpha_j H_{j,t+1} + \sum_{j=0}^{30} \beta_j H_{j,t} + a_{i,t}. \tag{4.2}$$

The trend cycle is assumed to have deterministic effect to simplify the outlier detection, thus trend variable is added to the initial regression model and the non-seasonal differencing order will be zero. The seasonality will be captured by seasonal ARIMA orders, thus no dummy variables for month are needed.

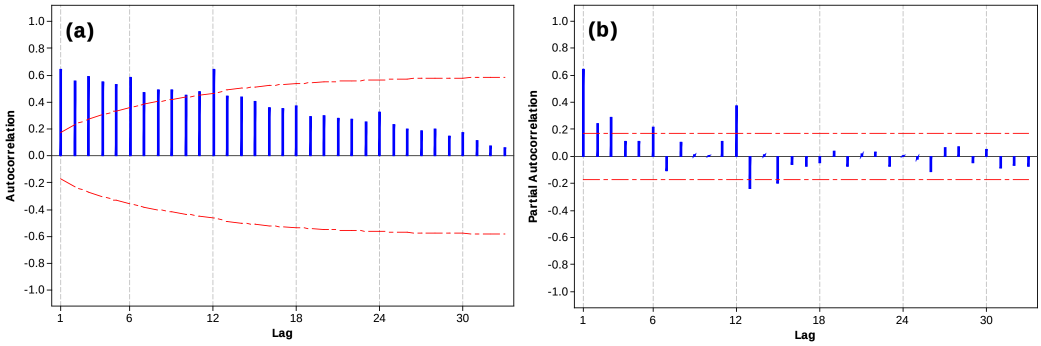

Figure 4.3 (a) ACF and (b) PACF plot of residual of initial model for national inflow data.

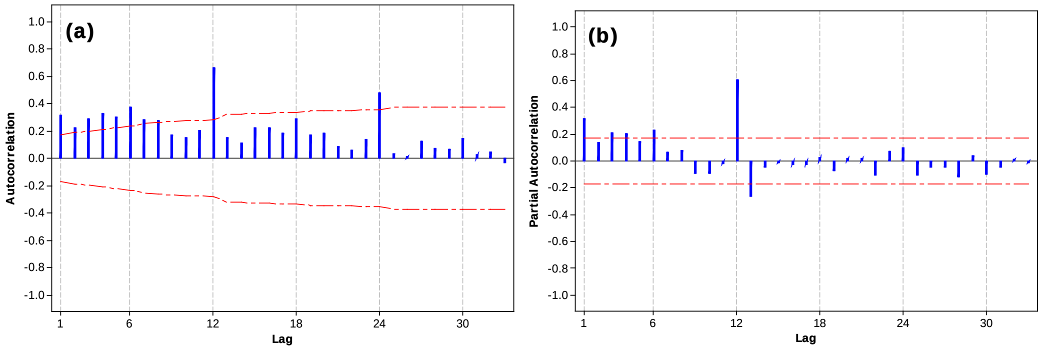

Figure 4.4 (a) ACF and (b) PACF plot of residual of initial model for national outflow data.

Figure 4.3 and 4.4 show that the initial model do not produce independent residual because the autocorrelation and partial autocorrelation are out of the 0.05 significant limits. The ACF plots show dies down pattern, whereas the PACFs are significant al subset lag and cut off at lag 12 for seasonal order. The plots indicate that the models will have autoregressive order on non-seasonal and seasonal lags. To make the residual independent, ARIMA orders are added to the initial models based on ACF and PACF identification. Additionally, dummy variables for outliers are added until the residuals are normally distributed. The final estimates of the first level ARIMAX models are shown on Table 4.1 and 4.2.

Table 4.1 Parameter estimates of the first level ARIMAX model for national inflow data

Parameter	Estimate	T	p-value	Parameter	Estimate	T	p-value
ϕ_1	0.4557	4.67	<0.0001	γ_{13}	9799.4	2.55	0.0122
ϕ_2	0.4103	4.19	<0.0001	γ_2	6729.0	1.93	0.0564
Φ_1	0.8450	11.82	<0.0001	γ_{23}	9290.9	1.77	0.0806
μ_1	306.4	2.53	0.0130	γ_{12}	7135.6	1.62	0.1075

Table 4.1 (Extension)

Parameter	Estimate	T	p-value	Parameter	Estimate	T	p-value
β_{24}	-3929.0	-1.13	0.2594	γ_{0}	219.9	0.06	0.9508
β_{13}	15309.4	3.50	0.0007	γ_{19}	16003.9	3.74	0.0003
β_{2}	24140.4	5.10	<0.0001	γ_{9}	1543.6	0.39	0.7008
β_{23}	2069.6	0.55	0.5867	γ_{30}	44438.2	8.47	<0.0001
β_{12}	15377.2	3.58	0.0005	γ_{18}	9661.6	1.71	0.0909
β_{0}	25986.2	5.75	<0.0001	γ_{7}	2649.3	0.45	0.6556
β_{19}	4717.0	1.30	0.1973	γ_{27}	0.0	-	-
β_{9}	24203.3	5.02	<0.0001	υ_{48}	-12109.6	-2.99	0.0035
β_{30}	-5007.2	-1.35	0.1797	ω_{95}	15453.8	4.46	<0.0001
β_{18}	23887.9	5.07	<0.0001	ω_{96}	11413.7	3.31	0.0013
β_{7}	55851.8	10.58	<0.0001	ω_{97}	-25265.1	-7.99	<0.0001
β_{27}	0.0	-	-	ω_{98}	-7048.5	-2.37	0.0197
γ_{24}	23108.1	7.01	<0.0001	ω_{121}	15228.3	4.19	<0.0001

Table 4.2 Parameter estimates of the first level ARIMAX model for national outflow data

Parameter	Estimate	T	p-value	Parameter	Estimate	T	p-value
ϕ_{1}	0.2872	3.03	0.0031	α_{27}	0.0	-	-
ϕ_{3}	0.4989	5.65	<0.0001	β_{24}	21609.3	4.29	<0.0001
Φ_{1}	0.9469	15.45	<0.0001	β_{13}	15262.9	2.62	0.0103
μ_{1}	366.9	2.20	0.0304	β_{2}	-4910.4	-0.96	0.3418
α_{24}	6992.4	1.31	0.1944	β_{23}	23502.7	3.08	0.0026
α_{13}	12602.1	1.83	0.0701	β_{12}	23969.9	3.49	0.0007
α_{2}	29001.9	3.86	0.0002	β_{0}	-1782.5	-0.33	0.7392
α_{23}	4361.5	0.82	0.4164	β_{19}	38885.1	5.76	<0.0001
α_{12}	3840.4	0.57	0.5709	β_{9}	28377.8	5.06	<0.0001
α_{0}	38307.1	5.34	<0.0001	β_{30}	57693.1	6.26	<0.0001
α_{19}	1812.0	0.32	0.7479	β_{18}	56592.1	5.44	<0.0001
α_{9}	7734.1	1.00	0.3190	β_{7}	11865.3	1.05	0.2981
α_{30}	2719.8	0.48	0.6315	β_{27}	0.0	-	-
α_{18}	9894.0	1.26	0.2096	υ_{49}	-9661.4	-2.44	0.0162
α_{7}	51083.5	5.51	<0.0001	ω_{96}	36081.9	7.53	<0.0001

Based on Table 4.1, the first level model for national currency inflow can be written as:

$$\begin{aligned} Y_{1,t} &= 306.4t + \sum_{j=0}^{30} \beta_j H_{j,t} + \sum_{j=0}^{30} \gamma_j H_{j,t-1} - \frac{1}{(1-B)} 12109.6 S_t^{(48)} + 15453.8 A_t^{(95)} \\ &+ 11413.7 A_t^{(96)} - 25265.1 A_t^{(97)} - 7048.5 A_t^{(98)} + 3631.5 A_t^{(121)} \\ &+ \frac{1}{(1-0.46B-0.41B^2)(1-0.85B^{12})} a_{1,t} \end{aligned} \tag{4.3}$$

and based on table 4.2, the first level model for national currency outflow is:

$$\begin{aligned} Y_{1,t} &= 366.9t + \sum_{j=0}^{30} \alpha_j H_{j,t+1} + \sum_{j=0}^{30} \beta_j H_{j,t} - \frac{1}{(1-B)} 9661.4 S_t^{(49)} + 36081.9 A_t^{(96)} \\ &+ \frac{1}{(1-0.29B-0.50B^3)(1-0.95B^{12})} a_{1,t}. \end{aligned} \tag{4.4}$$

As seen on Table 4.1 and 4.2, α_{27}, β_{27} and γ_{27} cannot be estimated because there is no Eid al-Fitr happens on date 28 during 2003 – 2013. Those parameter estimates are required to forecast currency inflow and outflow in 2014 because Eid al-Fitr happens on July 28, 2014. Therefore, second level models are needed to estimate α_j, β_j and γ_j for every possible values of j.

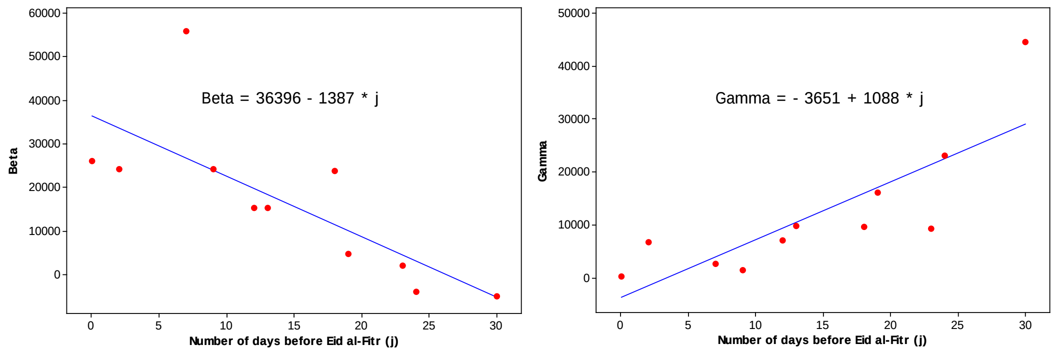

Figure 4.5 Second level models of national currency inflow.

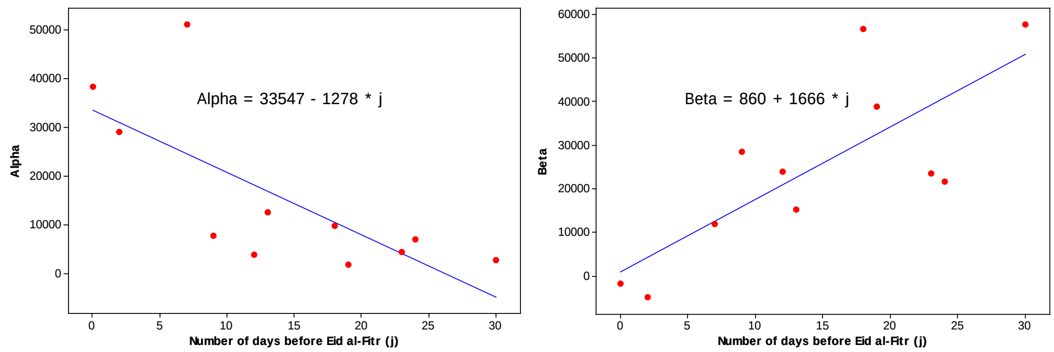

Figure 4.6 Second level models of national currency outflow.

The second level models are displayed on Figure 4.5 and 4.6. The models explain that the later Eid al-Fitr happens in certain month, the lower inflow increases in that month and the higher inflow increases in the next month. The later Eid al-Fitr happens in certain month, the higher outflow increases in that month and the lower outflow increases in the previous month. The remaining series at level 1 and 2 of the hierarchy have the similar structure of the second level models as shown in Appendix 7 and 8.

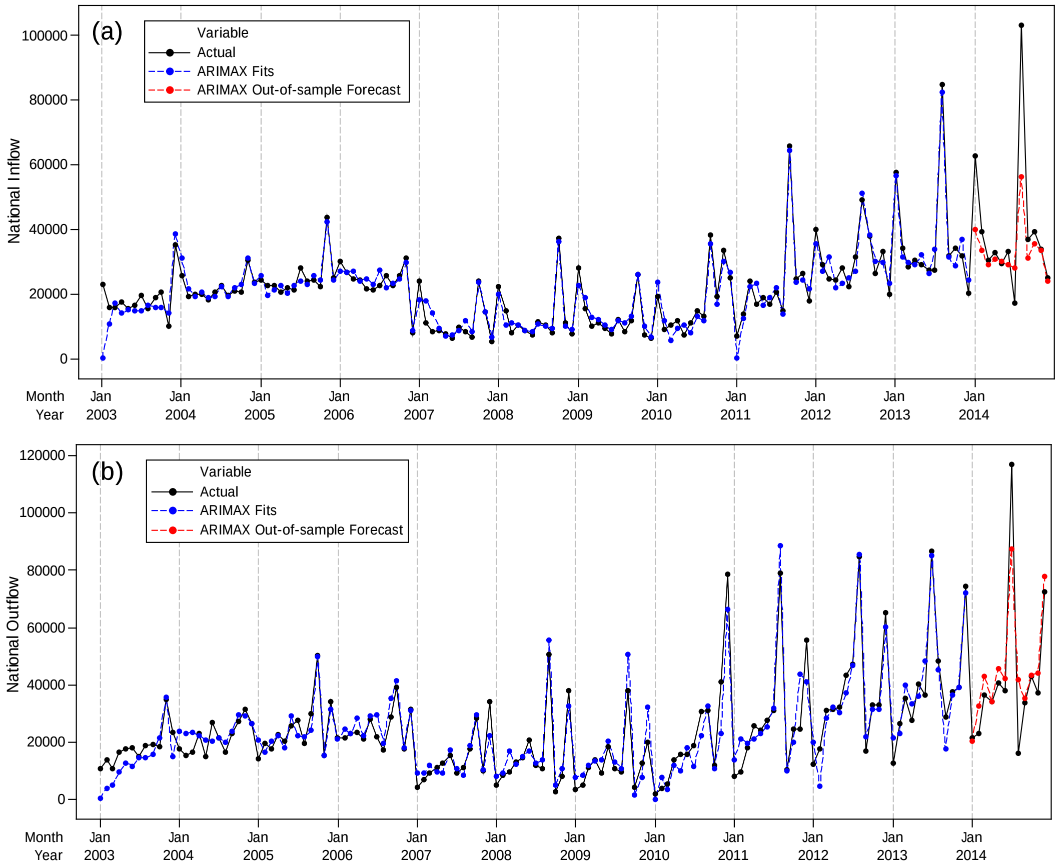

Figure 4.7 Forecast of national currency (a) inflow and (b) outflow by ARIMAX model.

Forecasting results by two levels ARIMAX models for national data are displayed on Figure 4.7. The fitted values can follow the patterns of the data and nicely fits the actual in-sample data on months around Eid al-Fitr. The forecast for outflow data looks good, whereas the forecast for inflow data is far from the actual data on month January and August.

4.3 Hybrid ARIMAX-ANN Models of Currency Circulation Data

Hybrid methods are applied on all of the two levels ARIMAX models in order to reduce the error of the models. The error can be minimized if it can be forecasted. Therefore, the hybrid method works by forecasting the future error based on the past residual. Modeling the residual is more complicated because it only contains nonlinear component due to the independent assumption of ARIMAX model, therefore a nonlinear model is needed. Specifying univariate model for nonlinear component is different from specifying linear model such as ARIMA. In ARIMA modeling, the input can be determined based on significant lags indicated by the autocorrelation and partial autocorrelation. Those autocorrelation only can explain the linear autocorrelation. Unfortunately, there is no statistical tools for determining the significance of nonlinear autocorrelation and partial autocorrelation. Therefore, this study is limited to use only lag 1, 2 and 3 of the residual as the inputs, thus the nonlinear function is $\hat{a}_t = f(a_{t-1}, a_{t-2}, a_{t-3})$ determined by ANN function.

After the inputs are determined, the number of neurons in hidden layer of ANN is selected by using cross-validation procedure based on the root mean square error (RMSE) of the out-of-sample data. The trials are using up to five number of hidden neurons. The results showed that the inflow and outflow data exact varying optimum number of hidden neurons. For example, the best ANN structures for national inflow and outflow data respectively are ANN(3,5,1) and ANN(3,1,1) as displayed on Table 4.3.

Table 4.3 Model selection for national currency inflow and outflow data

Model	RMSE on Inflow Data		RMSE on Outflow	
	In-sample	Out-of-sample	In-sample	Out-of-sample
ARIMAX	3449.8	15626.3	5575.0	12280.7
ARIMAX-ANN(3,1,1)	2719.5	15559.2	5173.8	**12182.7**
ARIMAX-ANN(3,2,1)	2609.9	15677.9	4922.4	12300.2
ARIMAX-ANN(3,3,1)	2517.8	15651.6	4652.3	12275.0
ARIMAX-ANN(3,4,1)	2395.5	15771.4	4424.0	12289.9
ARIMAX-ANN(3,5,1)	2330.9	**15530.3**	4151.5	12411.4

Table 4.3 shows that the hybrid treatment can significantly reduce the error of ARIMAX on in-sample data. Higher number of hidden neurons yields better forecast for in-sample data. On the out-of-sample data, more hidden neurons does

not always yields better forecast. Selecting the right number of hidden neurons is very important because not all ANN can reduce the error of ARIMAX. The structure of the best ANN with its parameter estimates for national inflow and outflow data are displayed on Figure 4.8.

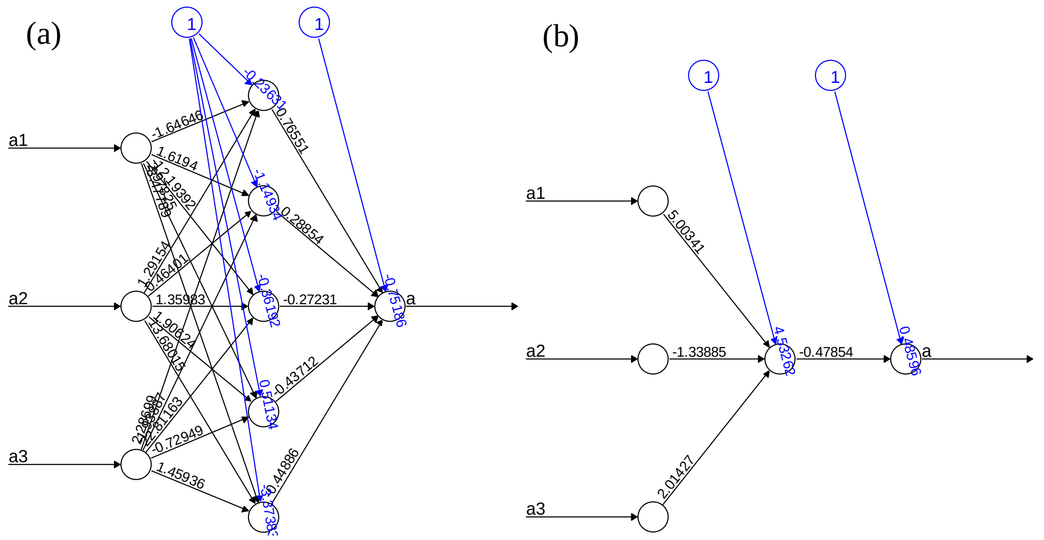

Figure 4.8 Architecture of ANN for the residual of national (a) inflow and (b) outflow data.

The ANN models are using hyperbolic tangent function in the hidden layer and linear function in the output layer. Therefore, the model for the residual of national inflow data can be mathematically written as follows:

$$\hat{a}_t = -0.75 + 0.77\, f_1^h(\bullet) + 0.29\, f_2^h(\bullet) - 0.27\, f_3^h(\bullet) - 0.44\, f_4^h(\bullet) - 0.45\, f_5^h(\bullet) \qquad (4.5)$$

where:

$$f_1^h(\bullet) = \frac{e^{2(-0.24-1.65a_{t-1}+1.29a_{t-2}+2.29a_{t-3})} - 1}{e^{2(-0.24-1.65a_{t-1}+1.29a_{t-2}+2.29a_{t-3})} + 1}$$

$$f_2^h(\bullet) = \frac{e^{2(-1.15+1.62a_{t-1}+0.46a_{t-2}-1.94a_{t-3})} - 1}{e^{2(-1.15+1.62a_{t-1}+0.46a_{t-2}-1.94a_{t-3})} + 1}$$

$$f_3^h(\bullet) = \frac{e^{2(-0.36-12.19a_{t-1}+1.36a_{t-2}+22.81a_{t-3})} - 1}{e^{2(-0.36-12.19a_{t-1}+1.36a_{t-2}+22.81a_{t-3})} + 1}$$

$$f_4^h(\bullet) = \frac{e^{2(0.51+2.98a_{t-1}+1.91a_{t-2}-0.73a_{t-3})} - 1}{e^{2(0.51+2.98a_{t-1}+1.91a_{t-2}-0.73a_{t-3})} + 1}$$

$$f_5^h(\bullet) = \frac{e^{2(-3.37-8.48a_{t-1}+13.68a_{t-2}+1.46a_{t-3})} - 1}{e^{2(-3.37-8.48a_{t-1}+13.68a_{t-2}+1.46a_{t-3})} + 1}$$

and ANN(3,1,1) model for the residual of national currency outflow is:

$$\hat{a}_t = 0.49 - 0.48\, f_1^{\,h}(\bullet) \tag{4.6}$$

where:

$$f_1^{\,h}(\bullet) = \frac{e^{2\left(4.53+5.00a_{t-1}-1.34a_{t-2}+2.01a_{t-3}\right)}-1}{e^{2\left(4.53+5.00a_{t-1}-1.34a_{t-2}+2.01a_{t-3}\right)}+1}.$$

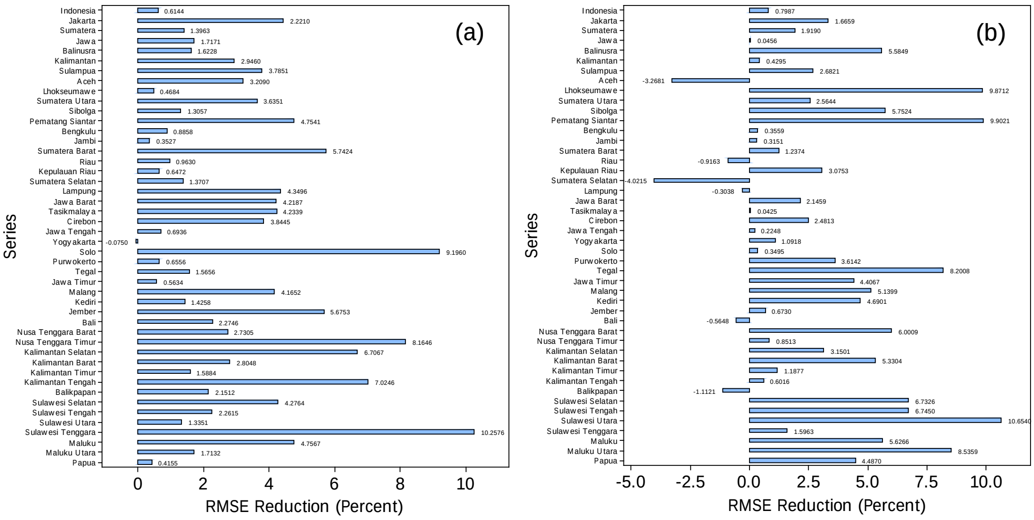

Figure 4.9 RMSE reduction by hybrid method on currency (a) inflow and (b) outflow data.

Figure 4.9 shows that the hybrid method can improve the accuracy of the two levels ARIMAX models for most of the series. The improvements are up to 10.26 and 10.65 percent respectively for inflow and outflow series. On inflow series, only one ARIMAX model that cannot be improved by hybrid method, whereas there are six ARIMAX models of outflow data that better not be treated by hybrid method. The forecasting will only use the best model for each series. It means that the unimproved ARIMAX models will not be added by ANN.

4.4 Hierarchical Forecast of Currency Inflow and Outflow

Hierarchical forecast is obtained by revising individual forecasts simultaneously by using specific method. Firstly, the summing matrix ***S*** is determined by writing the hierarchical structure of the data in matrix form. Based on the information from Figure 2.5, the hierarchical structure of currency inflow, as well as outflow data can be written as follows:

$$
\begin{array}{ccccc}
\boldsymbol{Y}_t & = & \boldsymbol{S} & \boldsymbol{Y}_{K,t} & \\
\begin{bmatrix} \boldsymbol{Y}_{1,t} \\ \boldsymbol{Y}_{2,t} \\ \boldsymbol{Y}_{3,t} \\ \boldsymbol{Y}_{4,t} \\ \boldsymbol{Y}_{5,t} \\ \vdots \\ \boldsymbol{Y}_{47,t} \end{bmatrix} & = & \begin{bmatrix} 1111111111111111111111111111111111111111 \\ 1000000000000000000000000000000000000000 \\ 0111111111111000000000000000000000000000 \\ 0000000000000111111111111000000000000000 \\ 0000000000000000000000000111000000000000 \\ 0000000000000000000000000000111110000000 \\ 0000000000000000000000000000000001111111 \\ \\ \boldsymbol{I}_{(40\times 40)} \\ \\ \end{bmatrix} & \begin{bmatrix} \boldsymbol{Y}_{8,t} \\ \boldsymbol{Y}_{9,t} \\ \boldsymbol{Y}_{10,t} \\ \boldsymbol{Y}_{11,t} \\ \boldsymbol{Y}_{12,t} \\ \vdots \\ \boldsymbol{Y}_{47,t} \end{bmatrix} & .
\end{array}
\tag{4.7}
$$

The individual forecasts are then revised by using the following equation:

$$\tilde{\boldsymbol{Y}}_{132}(l) = \boldsymbol{SP}\hat{\boldsymbol{Y}}_{132}(l) \tag{4.8}$$

where $\boldsymbol{P}$ is the proportion matrix defined by hierarchical method. In the next section, the forecast by each hierarchical method are compared to the individual forecast without revision.

4.4.1 Bottom-up Forecast

In bottom-up forecasting, the proportion matrix is $\boldsymbol{P} = [\boldsymbol{0}_{40\times 7} \mid \boldsymbol{I}_{40\times 40}]$. This matrix $\boldsymbol{P}$ sums up the individual forecast at level 2 to obtain the forecast at level 0 and 1, thus this revision only modify the forecast at level 0 and 1.

Table 4.4 RMSE of bottom-up forecast on currency inflow data

Forecast	Level 0		Level 1	
Periods (l)	Individual	Bottom-up	Individual	Bottom-up
1	**22522.7**	24092.8	**3675.4**	4015.5
2	**16176.0**	17356.2	**2699.6**	2902.0
3	**13246.1**	14177.2	**2216.2**	2378.5
4	**11490.9**	12307.0	**1927.1**	2069.1
5	**10290.4**	11026.8	**1753.9**	1875.4
6	**9553.1**	10147.9	**1615.6**	1726.4
7	**9882.3**	10320.6	**1695.0**	1776.1
8	18882.7	**18381.8**	**3086.8**	3109.3
9	17896.0	**17442.9**	**2928.5**	2957.2
10	17011.5	**16588.1**	**2786.3**	2815.5
11	16219.9	**15817.3**	**2659.6**	2687.3
12	15530.3	**15166.1**	**2550.6**	2579.0

Table 4.5 RMSE of bottom-up forecast on currency outflow data

Forecast	Level 0		Level 1	
Periods (l)	Individual	Bottom-up	Individual	Bottom-up
1	1557.3	**1532.5**	1002.6	**1001.5**
2	**6591.7**	6754.5	**1239.1**	1362.4
3	**6532.8**	6554.5	**1226.1**	1276.0
4	**5660.2**	5697.7	**1084.5**	1126.9
5	**5501.8**	5605.5	**1128.6**	1158.6
6	**5242.8**	5292.8	**1149.0**	1173.9
7	12295.5	**12112.8**	**2124.9**	2154.2
8	**14630.0**	14633.5	**2471.4**	2550.1
9	**13796.6**	13808.8	**2356.3**	2422.8
10	**13088.8**	13100.2	**2263.3**	2323.7
11	**12640.0**	12723.3	**2216.3**	2263.4
12	**12182.7**	12200.5	**2169.4**	2185.7

Table 4.4 shows that bottom-up method can improve the forecast accuracy on level 0 data, however level 1 data are better forecasted individually. Table 4.5 shows that the outflow data at level 0 and 1 are better forecasted directly.

4.4.2 Top-down Forecast Based on Historical Proportions (TDHP)

This method uses $\boldsymbol{P} = [\boldsymbol{p} \,|\, \boldsymbol{0}_{40\times39}]$, where $\boldsymbol{p} = [p_1, p_2, ..., p_{40}]'$ are calculated based on Equation (2.5) (TDHP-1) or Equation (2.6) (TDHP-2). This matrix disaggregates the level 0 forecast, thus this method only requires the forecast of level 0 data. However, Table 4.6 and 4.7 shows that the lower level series are better to be forecasted individually. The use of static historical proportions performs well until only 6-step ahead forecast on level 2 series.

Table 4.6 RMSE of TDHP forecast on currency inflow data

Forecast	Level 1			Level 2		
Periods (l)	Individual	TDHP-1	TDHP-2	Individual	TDHP-1	TDHP-2
1	**3675.4**	3753.8	3753.8	602.3	**564.1**	565.0
2	**2699.6**	2709.7	2707.5	444.7	420.1	**419.0**
3	**2216.2**	2223.0	2221.0	370.9	351.5	**350.2**
4	**1927.1**	1960.4	1955.3	328.5	319.3	**317.4**
5	1753.9	1757.0	**1752.2**	302.0	291.5	**289.4**
6	**1615.6**	1639.0	1634.1	285.3	279.1	**277.3**
7	**1695.0**	1747.9	1739.9	**292.5**	295.6	292.6
8	**3086.8**	3256.3	3252.9	**486.8**	510.9	509.5
9	**2928.5**	3088.2	3084.9	**466.9**	487.7	486.2
10	**2786.3**	2937.6	2934.1	**446.8**	467.5	466.0
11	**2659.6**	2804.2	2801.0	**429.8**	448.9	447.2
12	**2550.6**	2687.8	2684.8	**415.1**	432.4	430.8

Table 4.7 RMSE of TDHP forecast on currency outflow data

Forecast	Level 1			Level 2		
Periods (l)	Individual	TDHP-1	TDHP-2	Individual	TDHP-1	TDHP-2
1	1002.6	**793.5**	795.5	195.0	158.4	**155.4**
2	**1239.1**	1254.6	1248.6	238.0	219.6	**217.0**
3	1226.1	1217.8	**1205.8**	228.0	216.1	**212.0**
4	1084.5	1087.6	**1084.0**	222.5	210.9	**207.5**
5	1128.6	**1057.0**	1058.7	233.1	215.4	**211.2**
6	1149.0	1005.3	**1005.1**	237.2	214.2	**209.8**
7	**2124.9**	2255.5	2225.0	**369.2**	389.8	380.4
8	**2471.4**	2659.8	2618.6	**428.3**	445.7	436.2
9	**2356.3**	2530.5	2488.0	**409.5**	427.1	418.2
10	**2263.3**	2409.2	2365.7	**396.7**	411.1	402.2
11	**2216.3**	2341.8	2293.9	**388.7**	400.7	391.1
12	**2169.4**	2367.5	2308.1	**381.8**	417.0	403.6

4.4.3 Top-down Forecast Based on Forecasted Proportions (TDFP)

In this method, the proportions are changing over time. Therefore, the individual forecasts are revised by using Equation (2.7) instead of (4.8).

Table 4.8 RMSE of TDFP forecast on currency inflow data

Forecast	Level 1		Level 2	
Periods (l)	Individual	TDFP	Individual	TDFP
1	**3675.4**	3753.8	602.3	**563.1**
2	**2699.6**	2729.6	444.7	**422.3**
3	**2216.2**	2241.7	370.9	**351.8**
4	**1927.1**	1949.8	328.5	**312.8**
5	**1753.9**	1767.4	302.0	**288.3**
6	**1615.6**	1642.9	285.3	**275.7**
7	**1695.0**	1707.7	292.5	**285.5**
8	**3086.8**	3204.5	**486.8**	500.7
9	**2928.5**	3043.5	**466.9**	479.4
10	**2786.3**	2895.7	**446.8**	458.6
11	**2659.6**	2763.3	**429.8**	440.8
12	**2550.6**	2647.6	**415.1**	424.9

Table 4.9 RMSE of TDFP forecast on currency outflow data

Forecast	Level 1		Level 2	
Periods (l)	Individual	TDFP	Individual	TDFP
1	1002.6	**805.8**	195.0	**189.0**
2	**1239.1**	1295.0	238.0	**235.9**
3	**1226.1**	1257.7	**228.0**	229.2
4	**1084.5**	1109.5	**222.5**	224.0
5	**1128.6**	1141.0	**233.1**	234.5
6	**1149.0**	1165.8	**237.2**	240.4
7	**2124.9**	2216.5	**369.2**	379.1
8	**2471.4**	2591.7	**428.3**	434.7

Table 4.9 (Extension)

Forecast	Level 1		Level 2	
Periods (l)	Individual	TDFP	Individual	TDFP
9	**2356.3**	2466.7	**409.5**	416.1
10	**2263.3**	2366.5	**396.7**	403.0
11	**2216.3**	2305.9	**388.7**	394.7
12	**2169.4**	2259.3	**381.8**	392.3

Table 4.8 shows that on currency inflow data, TDFP forecast is better than individual forecast only on level 2 series for up to 7-step ahead of forecast. Table 4.9 shows that on currency outflow data, TDFP forecast is better than the individual forecast only for 1 and 2-step ahead respectively on level 1 and level 2 series.

4.4.4 Optimal Combination Forecast

Optimal combination forecasts are obtained by revising all series at all hierarchy level using Equation (4.8), where $\boldsymbol{P} = (\boldsymbol{S}'\boldsymbol{S})^{-1}\boldsymbol{S}'$. Table 4.10 and 4.11 show that this method yields better forecast on level 0 data, compared to if the data are forecasted directly. However, the data at level 1 and 2 are better to be forecasted individually without the revision by optimal combination method.

Table 4.10 RMSE of optimal combination forecast on currency inflow data

Forecast	Level 0		Level 1		Level 2	
Periods (l)	Individual	Optimal	Individual	Optimal	Individual	Optimal
1	22522.7	**22470.9**	**3675.4**	3745.1	602.3	**561.8**
2	16176.0	**16158.7**	**2699.6**	2728.2	444.7	**419.9**
3	13246.1	**13218.0**	**2216.2**	2246.7	370.9	**353.9**
4	11490.9	**11464.5**	**1927.1**	1955.0	328.5	**314.8**
5	10290.4	**10269.8**	**1753.9**	1775.2	302.0	**290.6**
6	9553.1	**9511.7**	**1615.6**	1653.5	285.3	**278.3**
7	9882.3	**9857.1**	**1695.0**	1721.3	292.5	**287.4**
8	18882.7	**18754.5**	**3086.8**	3184.9	**486.8**	498.0
9	17896.0	**17770.6**	**2928.5**	3024.4	**466.9**	477.0
10	17011.5	**16892.2**	**2786.3**	2877.4	**446.8**	456.3
11	16219.9	**16106.1**	**2659.6**	2746.1	**429.8**	438.9
12	15530.3	**15420.5**	**2550.6**	2634.3	**415.1**	424.1

Table 4.11 RMSE of optimal combination forecast on currency outflow data

Forecast	Level 0		Level 1		Level 2	
Periods (l)	Individual	Optimal	Individual	Optimal	Individual	Optimal
1	1557.3	**1038.4**	1002.6	**844.9**	195.0	**189.0**
2	6591.7	**6445.5**	**1239.1**	1264.6	238.0	**230.9**
3	6532.8	**6445.8**	**1226.1**	1227.4	228.0	**224.6**
4	5660.2	**5582.4**	**1084.5**	1086.1	222.5	**221.7**

Table 4.11 (Extension)

Forecast	Level 0		Level 1		Level 2	
Periods (l)	Individual	Optimal	Individual	Optimal	Individual	Optimal
5	5501.8	**5449.4**	1128.6	**1115.8**	**233.1**	234.8
6	5242.8	**5191.4**	1149.0	**1142.8**	**237.2**	239.7
7	12295.5	**12191.0**	**2124.9**	2184.1	**369.2**	376.0
8	14630.0	**14504.1**	**2471.4**	2557.4	**428.3**	431.3
9	13796.6	**13679.1**	**2356.3**	2434.5	**409.5**	413.0
10	13088.8	**12977.3**	**2263.3**	2336.7	**396.7**	400.0
11	12640.0	**12541.2**	**2216.3**	2277.6	**388.7**	392.4
12	12182.7	**12080.0**	**2169.4**	2226.9	**381.8**	389.0

4.5 Performance Comparison of Hierarchical Forecasting Methods

The previous section shows that the revision by hierarchical methods cannot yields better forecast than the individual forecast, except for level 0 data. Level 0 data are better to be revised by using bottom-up or optimal combination method rather than to be forecasted directly. There is no hierarchical method that performs well for all hierarchy level. However, to make the forecast follow the hierarchy rule, a method must be selected. Figure 4.10 displays the performance comparison of hierarchical method for 12-step ahead forecast at each level and overall hierarchy level.

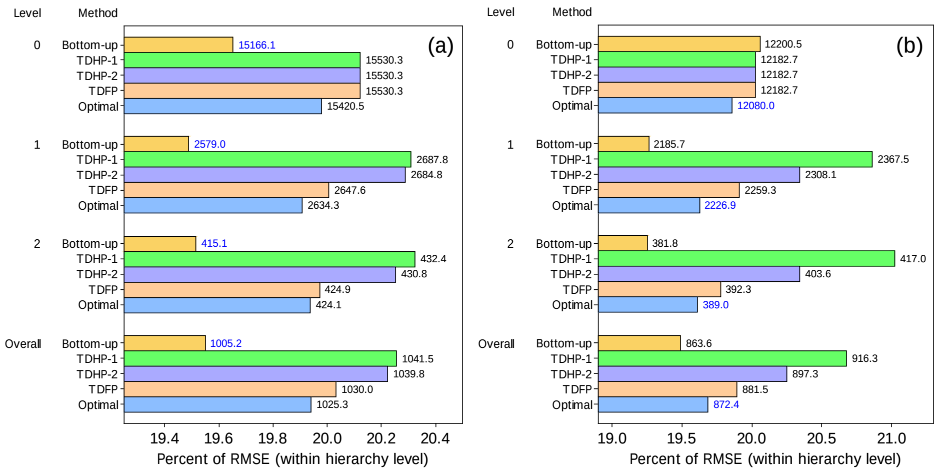

Figure 4.10 Performance comparison of hierarchical methods on currency (a) inflow and (b) outflow data based on hybrid ARIMAX-ANN individual forecasts.

According to Figure 4.10, the best method for forecasting currency inflow is bottom-up method. On outflow data, optimal combination method performs best at level 0 data. At the lower level, the best hierarchical method is optimal combination method. For the overall performance, it is clear that bottom-up method is the best method for forecasting hierarchical currency inflow and outflow.

It is very reasonable that bottom-up method has the best performance overall because the series at bottom level has different patterns of variation, especially in terms of the position of additive and level shift outliers. Moreover, it is because the bottom level has much higher number of series that affects the overall performance. Furthermore, the individual forecasts at bottom level are obtained by using hybrid model of two levels ARIMAX and ANN that has very good performance, thus the forecasts do not need to be revised by top-down or optimal combination method.

Now the performance of hierarchical methods are also based on individual forecasts obtained by ARIMAX models, which are the less accurate model. Figure 4.11 shows that optimal combination method performs best on inflow data at level 0 and 1. However, on inflow data at level 2, top-down methods with historical proportions are much better than the other methods, and TDHP-2 is slightly better than TDHP-1. It causes TDHP-2 method also be the best method on the overall inflow data. The performance comparison on outflow data is different. On outflow data, optimal combination method consistently outperforms the other methods at all hierarchy level, as well as on the overall data.

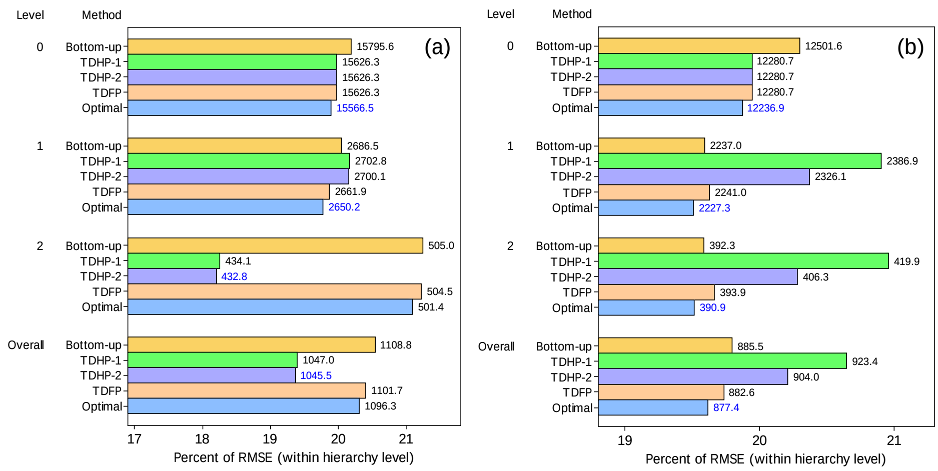

Figure 4.11 Performance comparison of hierarchical methods on currency (a) inflow and (b) outflow data based on ARIMAX individual forecasts.

4.6 Heteroscedasticity Before and After ARIMAX Modeling

Constructing the lower and upper limits of the hierarchical forecast requires the predicted values of variances. For the models that have meet homoscedasticity assumption, the forecast intervals can be calculated based on the standard error of the forecast error, whereas for the model with heteroscedasticity, the forecast intervals are based on the forecast of conditional variance of the forecast error. Based on portmanteau test, some models violate the homoscedasticity assumption.

Table 4.12 Number of heteroscedasticity before and after hybrid modeling.

ARIMAX	ARIMAX-ANN	Inflow		Outflow	
		Count	%	Count	%
Heteroscedasticity	Heteroscedasticity	8	17.4	12	26.1
	Homoscedasticity	15	32.6	13	28.3
Homoscedasticity	Heteroscedasticity	5	10.9	5	10.9
	Homoscedasticity	18	39.1	16	34.8

Table 4.12 shows that the hybrid method can reduce the number of models that have heteroscedasticity from 23 to 13 on inflow data and from 25 to 17 on outflow data. On inflow and outflow data, respectively 15 and 13 models become to meet homoscedasticity assumption after the hybrid modeling. However, there are 5 models on either inflow or outflow data that turn to heteroscedasticity after hybrid modeling.

4.7 Interval Forecast of Currency Inflow and Outflow

Interval forecasting procedure depends on the heteroscedasticity condition. Table 4.13 summarizes the number of series based on the best final model. There are total of 61 series, which their variance cannot be modeled. Nonetheless, there are 2 and 31 series, which their variance will be modeled based on minimum MSE and GARCH, respectively.

Table 4.13 Number of series based on the best final model.

Mean Model	Variance Model	Count		Total
		Inflow	Outflow	
ARIMAX	GARCH	1	4	5
	Minimum MSE	0	2	2
ARIMAX-ANN	GARCH	12	14	26
	-	34	27	61

It also should be noted that in this case, the interval only could be constructed on series that have not been revised by hierarchical method. Considering that bottom-up method is used, the forecast limits cannot be obtained on series at level 0 and 1, because it requires the variance estimates from all series at bottom level, while some of those variances cannot be estimated. The interval forecasting results can be seen on Appendix 12 and 13.

4.7.1 Interval Forecast for Series with Homoscedasticity

For the series that have met homoscedasticity assumption, the forecast intervals are constructed based on the variance estimate defined by Equation (2.74). However, this procedure only can be applied on the series that best modeled by ARIMAX because there is no procedure for variance estimation on hybrid model. There are two series, which are best modeled by ARIMAX with homoscedasticity, i.e. outflow in Aceh and outflow in Balikpapan. For example, this section explain the interval forecasting process on currency outflow in Aceh. This series follows an ARIMAX(2,0,0)(1,0,0)^{12} that is

$$Y_{9,t} = \mu_1 t + \frac{1}{(1-B)}\omega_{49} I_t^{(49)} + \frac{1}{(1-\phi_1 B - \phi_2 B^2)(1-\phi_{12}B^{12})} a_t \, . \tag{4.9}$$

To show the determination of ψ_j, lag 12 or higher can be ignored tentatively because the forecasts are up to 12 step ahead. Hence,

$$\psi(B)a_t = \frac{1}{(1-\phi_1 B - \phi_2 B^2)(1-\phi_{12}B^{12})} a_t$$

$$(1+\psi_1 B + \psi_2 B^2 + \psi_3 B^3 + ...)a_t = \frac{1}{(1-\phi_1 B - \phi_2 B^2 + ...)} a_t$$

$$\begin{aligned} a_t &= (1+\psi_1 B + \psi_2 B^2 + \psi_3 B^3 + ...)(1-\phi_1 B - \phi_2 B^2 + ...)a_t \\ &= (1-\phi_1 B - \phi_2 B^2 + \psi_1 B - \psi_1\phi_1 B^2 - \psi_1\phi_2 B^3 + \psi_2 B^2 - \psi_2\phi_1 B^3 - \psi_2\phi_2 B^4 \\ &\quad + \psi_3 B^3 - \psi_3\phi_1 B^4 - \psi_3\phi_2 B^5 + ...)a_t \\ &= a_t + (\psi_1 - \phi_1)a_{t-1} + (-\phi_2 - \psi_1\phi_1 + \psi_2)a_{t-2} + (-\psi_1\phi_2 - \psi_2\phi_1 + \psi_3)a_{t-3} + ... \, . \end{aligned}$$

Therefore,

$$\psi_0 = 1 \tag{4.10}$$

$$\begin{gathered} (\psi_1 - \phi_1)a_{t-1} = 0 \\ \psi_1 = \phi_1 \end{gathered} \tag{4.11}$$

$$
\begin{gathered}
(-\phi_2 - \psi_1\phi_1 + \psi_2)a_{t-2} = 0 \\
\psi_2 = \psi_1\phi_1 + \phi_2 \\
\psi_2 = \psi_1\psi_1 + \phi_2
\end{gathered}
\tag{4.12}
$$

$$
\begin{gathered}
(-\psi_1\phi_2 - \psi_2\phi_1 + \psi_3)a_{t-3} = 0 \\
\psi_3 = \psi_2\phi_1 + \psi_1\phi_2 \\
\psi_3 = \psi_2\psi_1 + \psi_1\phi_2.
\end{gathered}
\tag{4.13}
$$

From (4.12) and (4.13) obtained that

$$\psi_j = \psi_{j-1}\psi_{j-2} + \psi_{j-2}\phi_2 \tag{4.15}$$

for $j = 2,3,...,11$. By using this formula, the $(1-\alpha)\times 100\%$ forecast limits were obtained as shown on Table 4.14.

Table 4.14 Interval forecast for currency outflow in Aceh

l	$Y_{132}(l)$	$\hat{Y}_{132}(l)$	$\hat{\sigma}^2_{132}(l)$	L95	U95	Range
1	115.2	599.2	14357.6	364.3	834.0	469.7
2	262.9	611.0	15932.8	363.6	858.4	494.8
3	245.4	544.9	19951.8	268.0	821.7	553.7
4	356.4	576.7	21368.9	290.2	863.3	573.0
5	266.0	540.4	22894.1	243.8	837.0	593.1
6	553.9	749.5	23719.1	447.7	1051.4	603.7
7	755.9	729.3	24389.7	423.2	1035.4	612.2
8	148.2	568.5	24814.8	259.7	877.2	617.5
9	320.9	569.0	25127.6	258.3	879.7	621.4
10	449.5	594.1	25338.3	282.1	906.1	624.0
11	315.9	567.9	25487.5	255.0	880.8	625.8
12	838.9	799.3	25590.4	485.7	1112.8	627.1

As seen on Table 4.14, the forecasted variance certainly increase as the farther prediction in the future. It makes the interval of the forecast wider and the high step ahead forecast less precise.

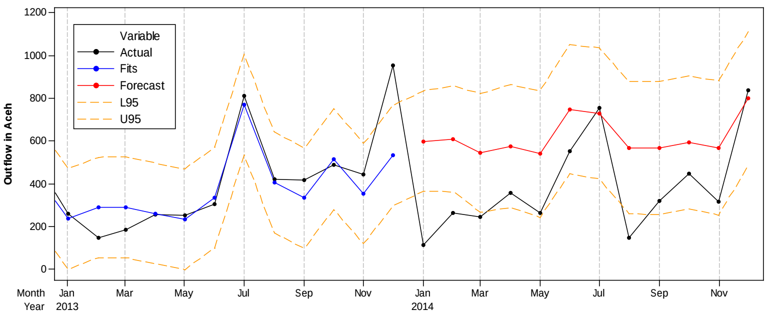

Figure 4.12 Interval forecast for currency inflow in Aceh.

Figure 4.12 visually shows that the forecast interval certainly becomes wider over time due to the variance formula. The forecast accuracy on this series is rather unsatisfactory because some actual values are out of the forecast interval. It is because there is seems to be a level shift outlier at January 2014 that cannot be handled by the model.

4.7.2 Interval Forecast for Series with Heteroscedasticity

For the model with heteroscedasticity, the conditional variance will be forecasted by GARCH model. The following sections will explain the example of interval forecasting on series with heteroscedasticity, which is currency outflow in Sumatera Selatan. The mean model for this series is ARIMAX model. The first step of GARCH modeling is to determine the *r* and *s* order of the GARCH(*r*,*s*) model based on the portmanteau test or the ACF and PACF.

Table 4.15 Portmanteau test for the residual of currency outflow in Sumatera Selatan

Order (K)	Q	$P(Q > \chi^2_{0.05;K})$	LM	$P(LM > \chi^2_{0.05;K})$
1	0.5260	0.4683	0.5145	0.4732
2	7.0670	0.0292	6.6245	0.0364
3	8.2030	0.0420	7.2492	0.0644
4	8.2639	0.0824	7.3972	0.1163
5	19.3567	0.0016	16.0488	0.0067
6	19.4205	0.0035	16.3561	0.0120
7	20.7581	0.0041	16.3663	0.0220
8	22.4938	0.0041	17.7553	0.0231
9	22.6601	0.0070	18.1818	0.0331
10	36.4199	<0.0001	24.2042	0.0071
11	37.9989	<0.0001	26.2737	0.0059
12	47.8742	<0.0001	28.9572	0.0040

Table 4.15 shows that the Q and LM statistics are significant from lag 2 through lag 12. According to Wei (2006, p. 373), the significant statistics on high K indicate a GARCH(*r*,*s*) model. However, the proper value of *r* and *s* are still cannot be identified by only using this test. Therefore, the identification of ACF and PACF of the squared residual are needed.

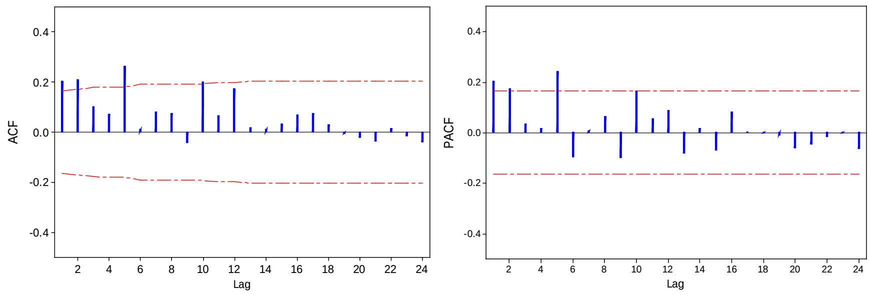

Figure 4.13 ACF and PACF plot of the squared residual of outflow data in Sumatera Selatan.

The ACF and PACF plot of the squared residual shown on Figure 4.13 cut off after lag 2 and indicate that the squared residual follow an ARMA(0,2), ARMA(2,0) or ARMA(1,1) process. These ARMA model can determine some possible GARCH orders.

Table 4.16 Order selection for GARCH model of national outflow

ARMA(m,r)	m	r	s	GARCH(r,s)	Parameter	Estimate	p-value	SBC
ARMA(0,1)	0	2	-	-	-	-	-	-
ARMA(2,0)	2	0	2	GARCH(0,2)	θ_0	76078	<0.0001	1865.5
					θ_1	0.0161	0.8269	
					θ_2	0.2300	0.1399	
			1	GARCH(0,1)	θ_0	76078	0.0001	1867.3
					θ_1	0.0358	0.6931	
			[2]	GARCH(0,[2])	θ_0	76078	<0.0001	**1860.9**
					θ_2	0.2322	0.1128	
ARMA(1,1)	1	1	1	GARCH(1,1)	θ_0	76078	<.0001	1867.3
					θ_1	0.0358	0.6931	
					ϕ_1	<0.0001	0.9999	
			0	-	-	-	-	-

As shown on Table 4.16, ARMA(0,2) gives no clue for possible GARCH order because the assumption is m=max(r,s). ARMA(2,0) indicates the GARCH(0,2) model, but if not all parameters are significant, the model may be reduced to GARCH(0,1) or GARCH(0,[2]). Moreover, ARMA(1,1) indicates GARCH(1,1) model. The results showed that there are no model that all of its parameters are significant. However, a best model must be selected. The parameters of GARCH(0,[2]) model are large enough and yield the smallest SBC value. Therefore, GARCH(0,[2]) will be used to forecast the conditional variance. This model can be written as follows:

$$\hat{\sigma}_t^2 = 76078 + 0.2322 n_{t-1}^2 \tag{4.9}$$

and the interval forecasting results are displayed on Table 4.17.

Table 4.17 Interval forecast for national outflow in Sumatera Selatan

l	$Y_{132}(l)$	$\hat{Y}_{132}(l)$	$\hat{\sigma}_{132}^2(l)$	L95	U95	Range
1	681.3	991.9	78405.0	443.1	1540.7	1097.6
2	728.4	1232.6	111288.9	578.8	1886.4	1307.7
3	1107.6	1279.6	94284.7	677.8	1881.4	1203.6

Table 4.17 (Extension)

l	$Y_{132}(l)$	$\hat{Y}_{132}(l)$	$\hat{\sigma}^2_{132}(l)$	L95	U95	Range
4	1145.9	1222.1	101920.7	596.4	1847.8	1251.4
5	970.1	1305.0	97972.1	691.6	1918.5	1227.0
6	1138.8	1455.5	99745.3	836.5	2074.5	1238.0
7	3375.8	2533.6	98828.4	1917.5	3149.8	1232.3
8	255.8	1259.7	99240.1	642.3	1877.2	1234.9
9	760.6	1358.4	99027.2	741.7	1975.2	1233.5
10	899.5	1310.1	99122.8	693.1	1927.2	1234.1
11	1010.0	1432.5	99073.4	815.6	2049.5	1233.8
12	1298.2	1992.7	99095.6	1375.8	2609.7	1234.0

The forecast of conditional variances are highly fluctuated in the beginning of forecasting and tend to be stable afterwards. Unlike the variance estimate on homoscedasticity series, the conditional variance does not certainly increase for the further prediction in the future. It makes the forecast interval not becomes wider over time, thus the model can be used for longer period of forecasting.

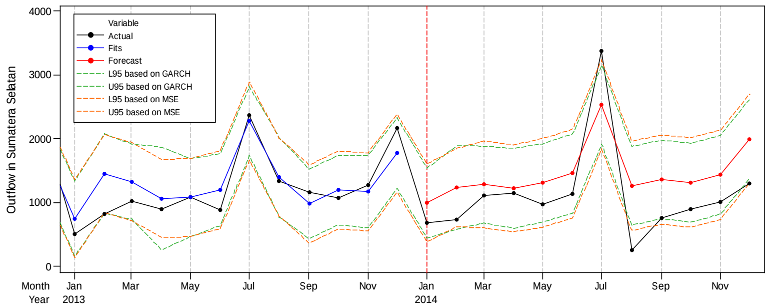

Figure 4.14 Interval forecast for currency outflow in Sumatera Selatan.

Figure 4.14 shows the visualization of the forecast. Based on the time series plot, the GARCH model can produce narrower interval compared to the interval based on the minimum MSE, especially for higher step of forecasting. Therefore, the use of GARCH model is more precise for long period interval forecasting. The actual data in out-of-sample are nicely stayed within the interval except for month July and August 2014, which are month with Eid al-Fitr and a month after Eid al-Fitr.

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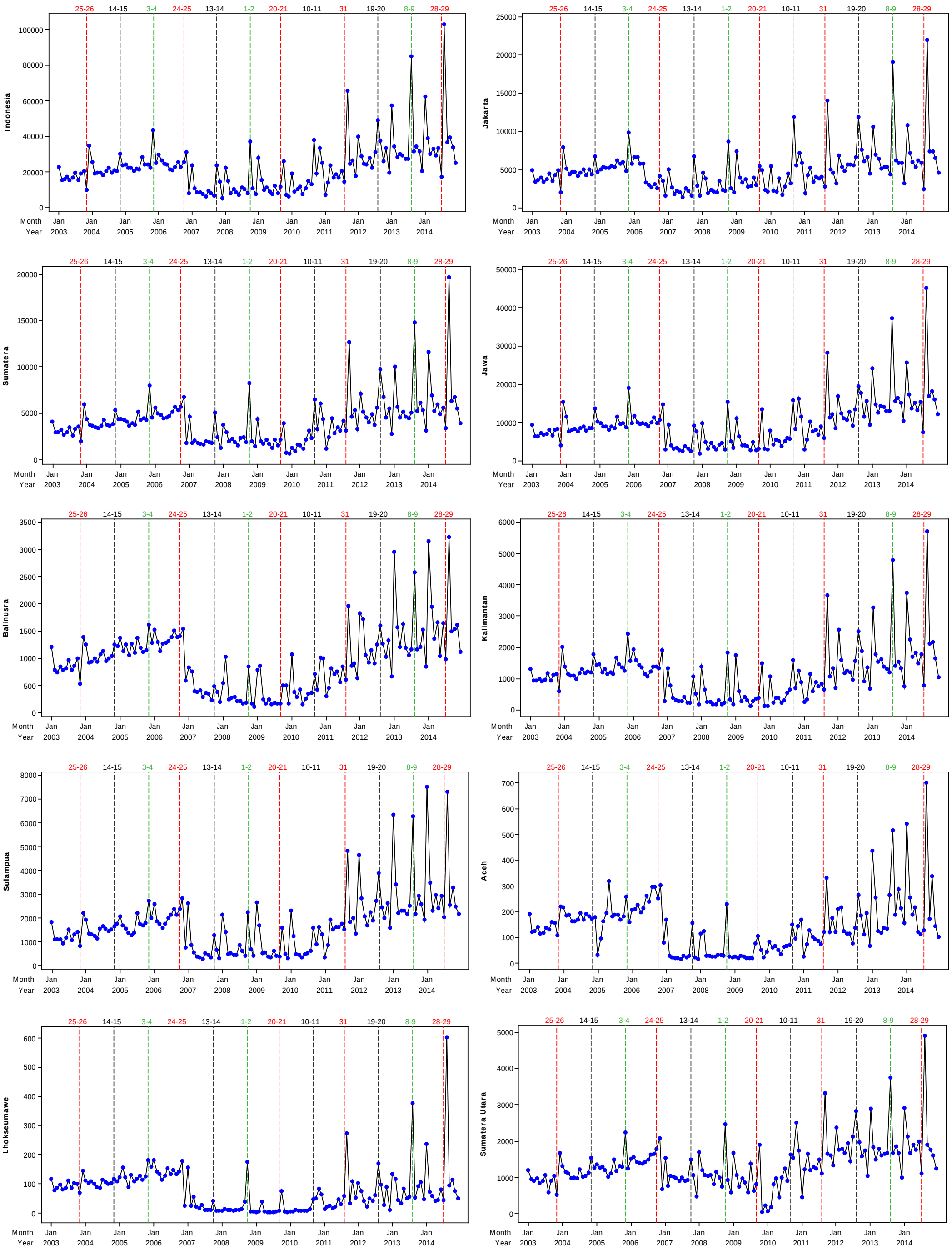
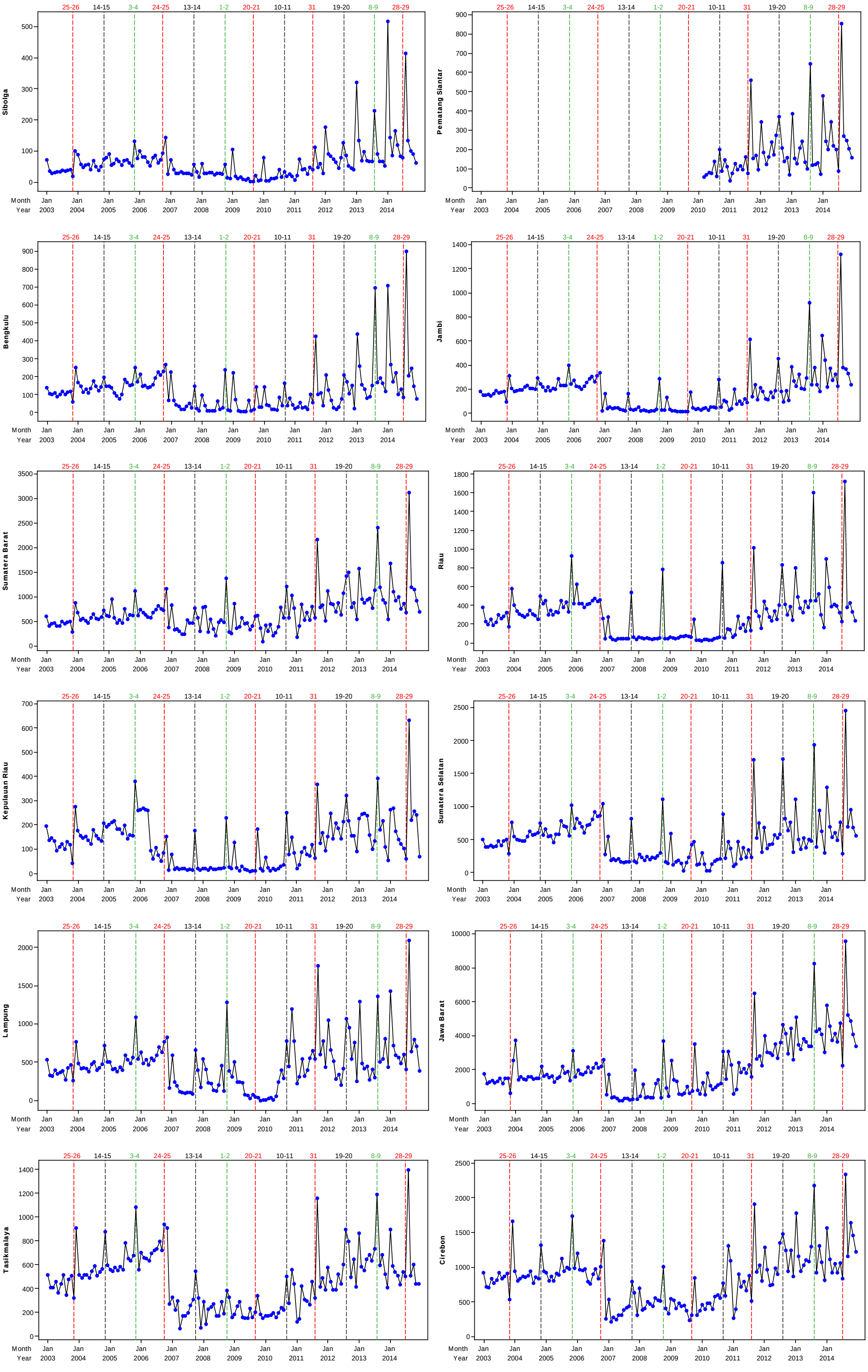
APPENDICES

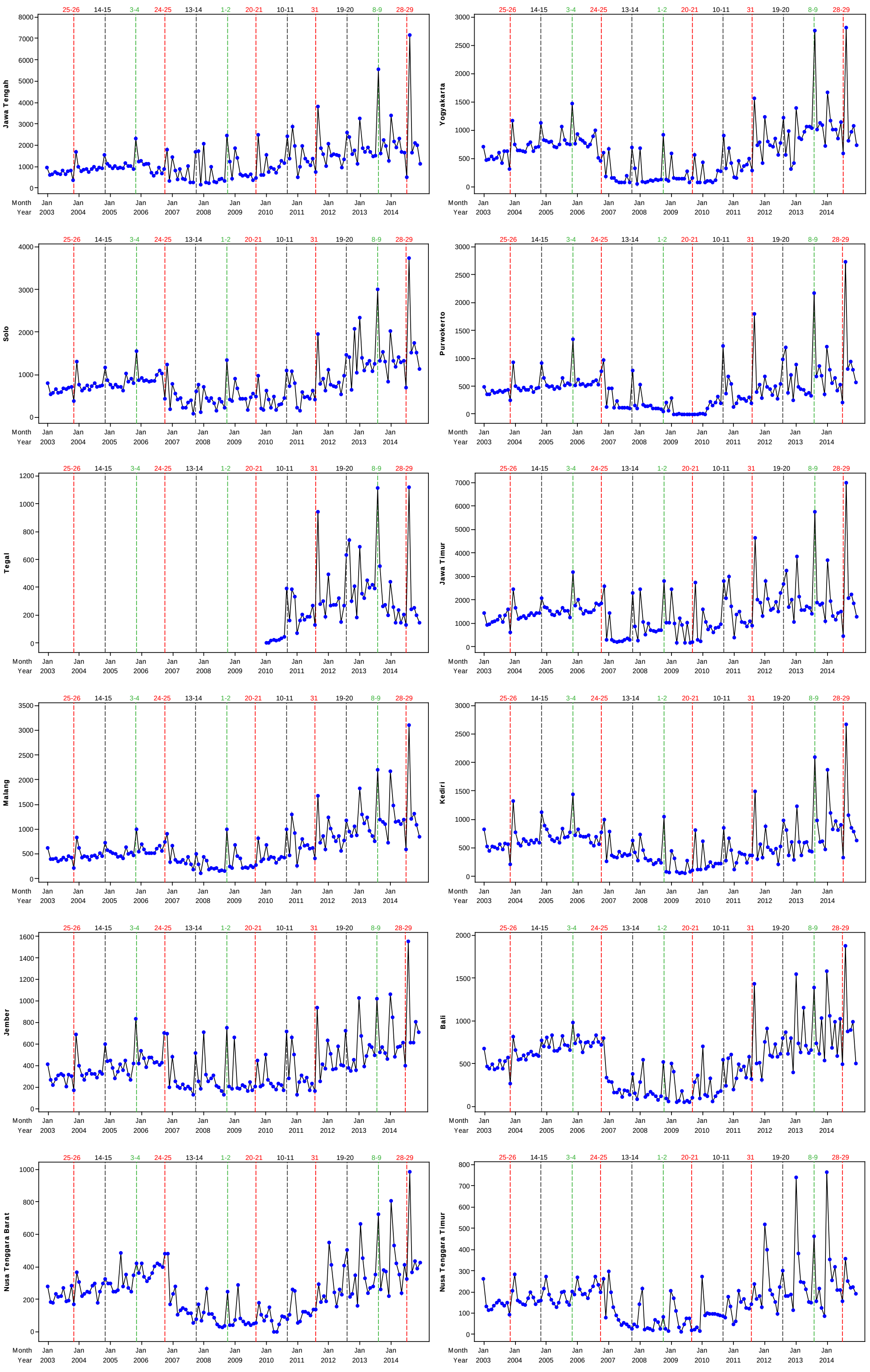
Appendix 1. Time Series Plot of Currency Inflow



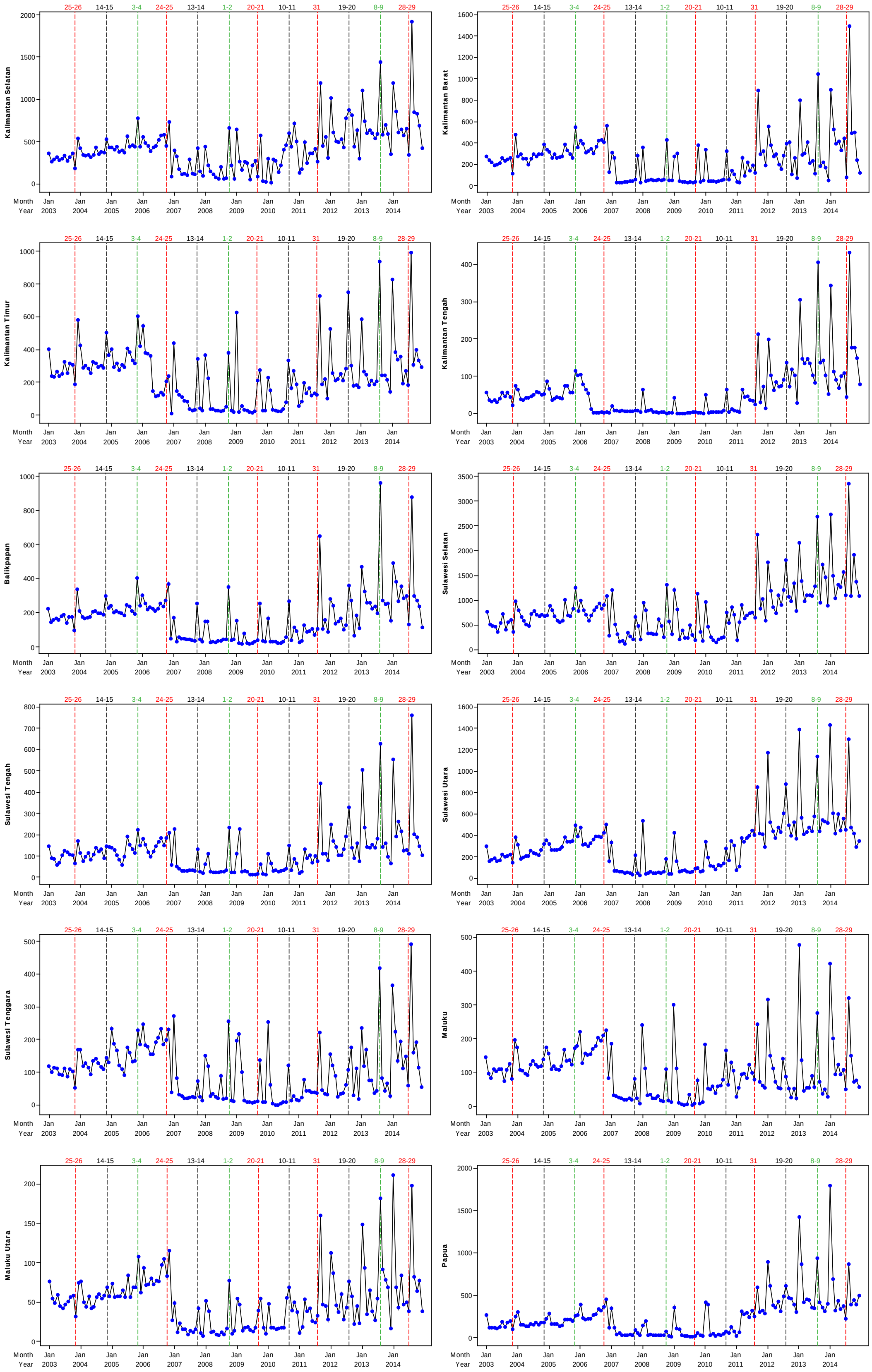
Appendix 1. (Extension)



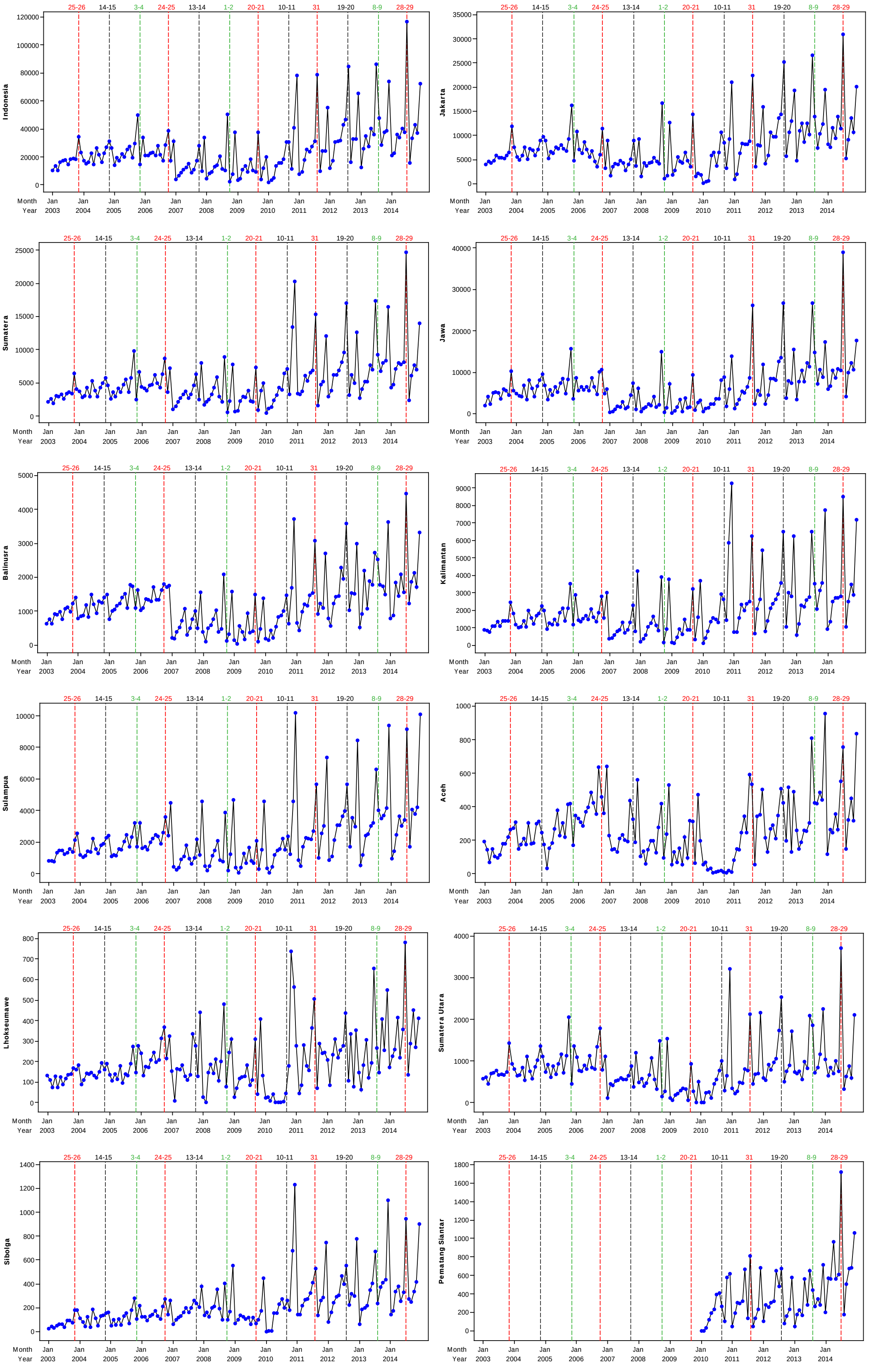
Appendix 1. (Extension)



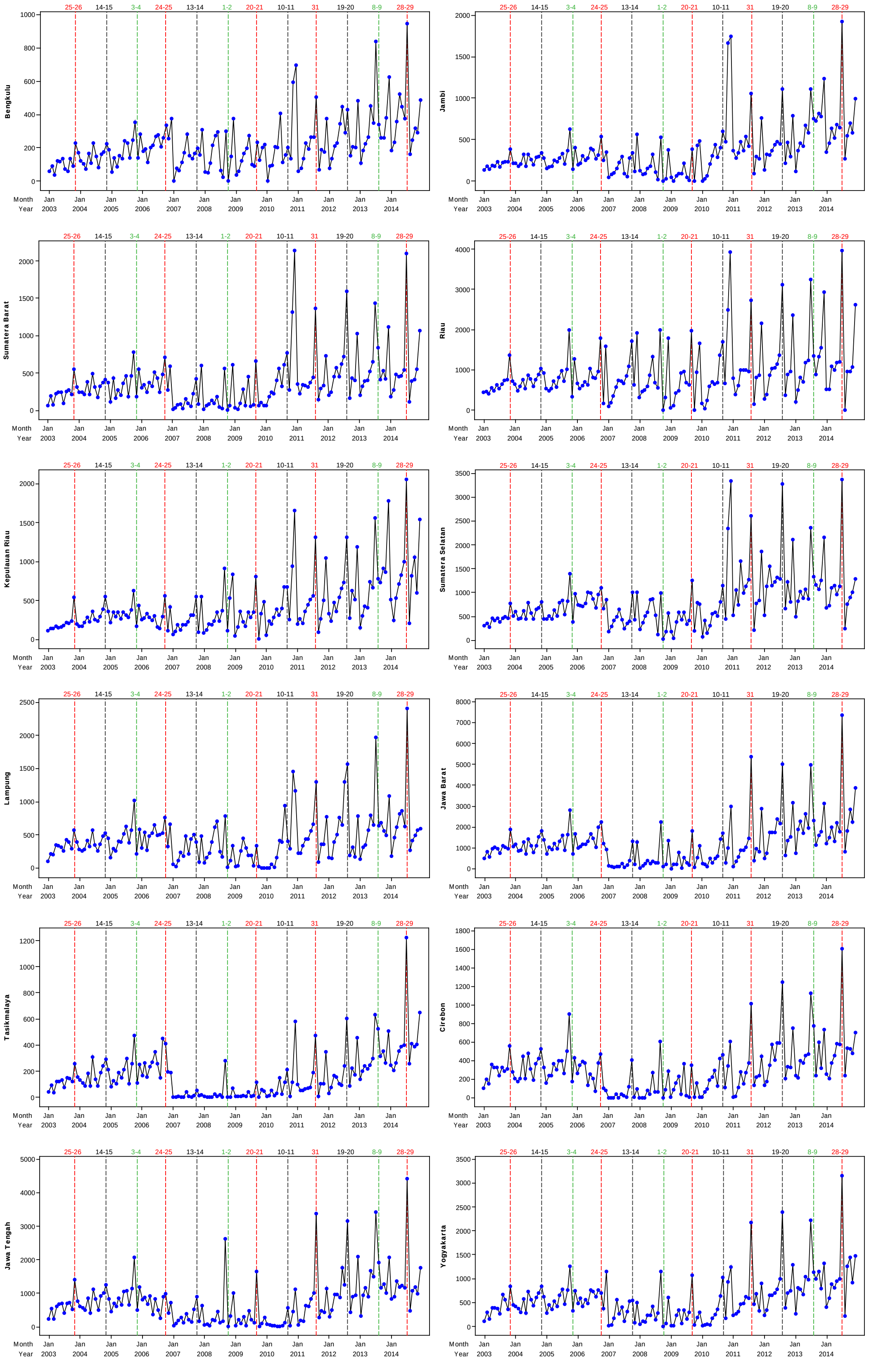
Appendix 1. (Extension)



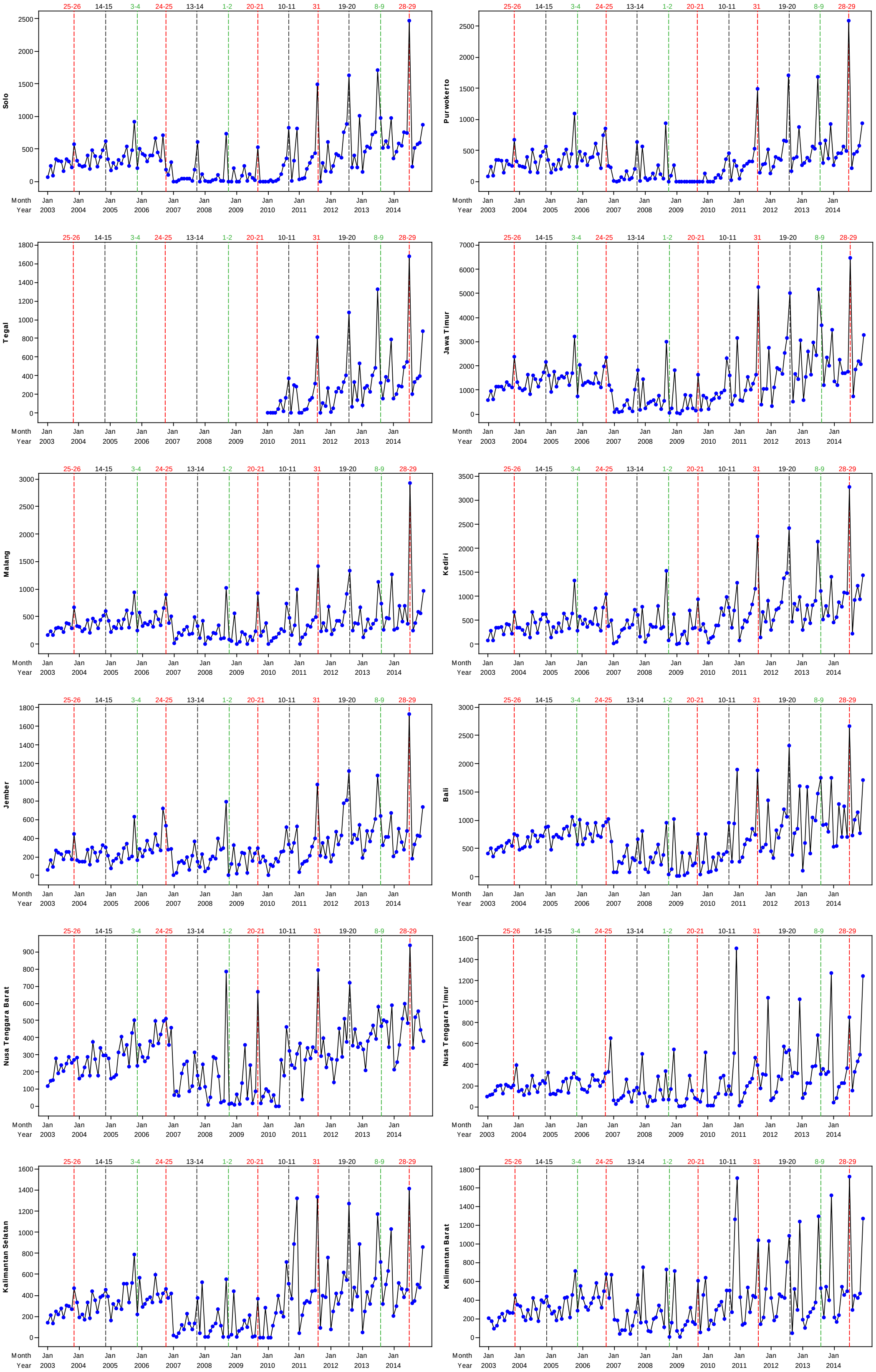
Appendix 2. Time Series Plot of Currency Outflow



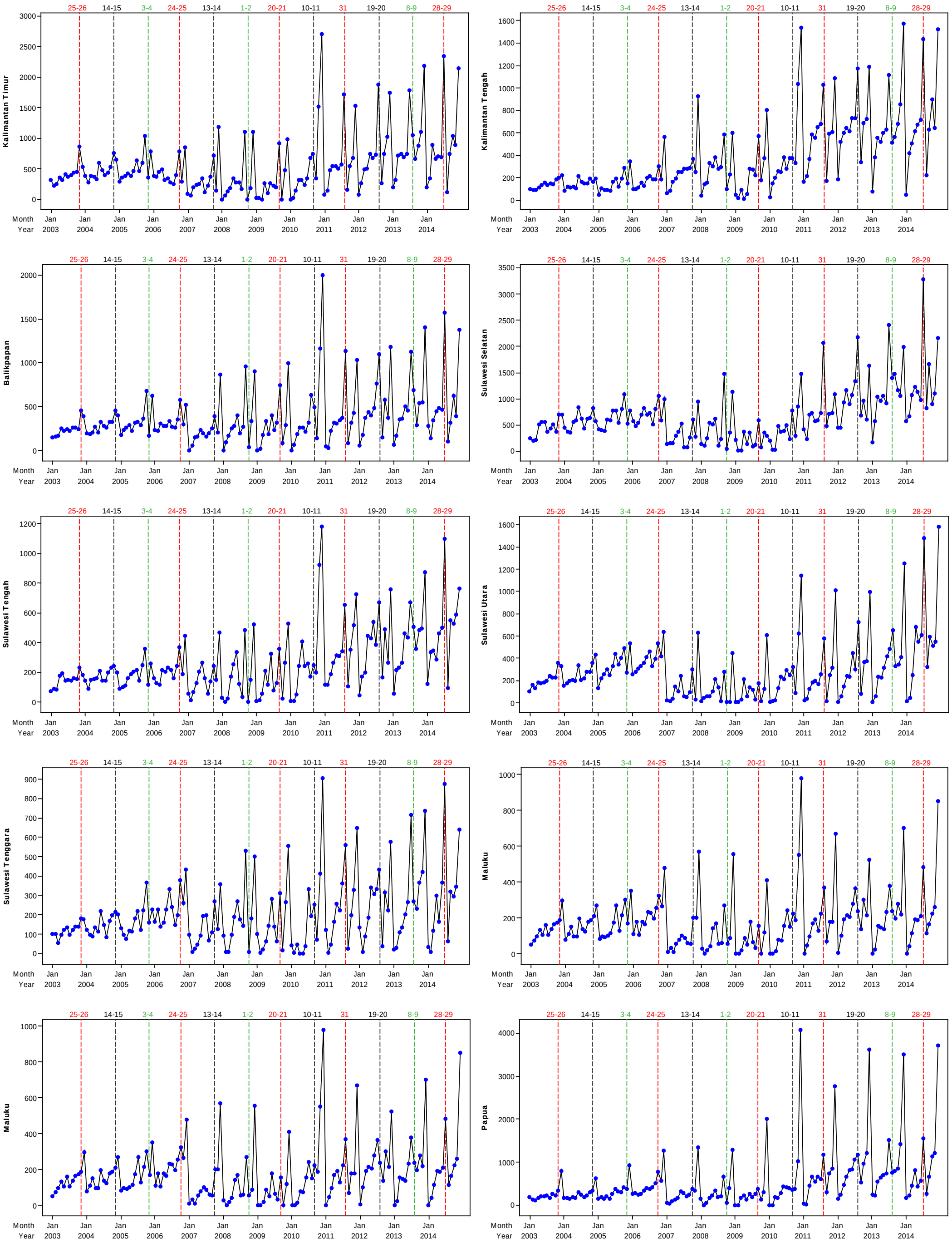
Appendix 2. (Extension)



Appendix 2. (Extension)



Appendix 2. (Extension)



Appendix 3. SAS Program for ARIMAX Modeling

```
data bi;
input
Y t
H24t H13t H2t H23t H12t H0t H19t  H9t H30t H18t H7t H27t
H24tp1 H13tp1 H2tp1 H23tp1 H12tp1 H0tp1 H19tp1 H9tp1 H30tp1 H18tp1 H7tp1 H27tp1
H24tm1 H13tm1 H2tm1 H23tm1 H12tm1 H0tm1 H19tm1 H9tm1 H30tm1 H18tm1 H7tm1 H27tm1
;
datalines;
22946.64  1    0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
15725.49  2    0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
15859.01  3    0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
:         :    : : : : : : : : : : : : : : : : : : : : : : : : : : : : : : : : : : : :
:         :    : : : : : : : : : : : : : : : : : : : : : : : : : : : : : : : : : : : :
20407.09  132  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
*         133  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
*         134  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
*         135  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
*         136  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
*         137  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
*         138  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0
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*         143  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
*         144  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
;

data bi;
set bi;
if _n_>=48 then S48=1;  else S48=0;
if _n_=95  then A95=1;  else A95=0;
if _n_=96  then A96=1;  else A96=0;
if _n_=97  then A97=1;  else A97=0;
if _n_=98  then A98=1;  else A98=0;
if _n_=121 then A121=1; else A121=0;
run;

proc arima data=bi out=result1;
identify var=Y crosscorr=(
t
H24t H13t H2t H23t H12t H0t H19t  H9t H30t H18t H7t H27t
H24tp1 H13tp1 H2tp1 H23tp1 H12tp1 H0tp1 H19tp1 H9tp1 H30tp1 H18tp1 H7tp1 H27tp1
H24tm1 H13tm1 H2tm1 H23tm1 H12tm1 H0tm1 H19tm1 H9tm1 H30tm1 H18tm1 H7tm1 H27tm1
S48 A95 A96 A97 A98 A121) nlag=36;
run;

estimate input=(
t
H24t H13t H2t H23t H12t H0t H19t  H9t H30t H18t H7t H27t
H24tm1 H13tm1 H2tm1 H23tm1 H12tm1 H0tm1 H19tm1 H9tm1 H30tm1 H18tm1 H7tm1 H27tm1
S48 A95 A96 A97 A98 A121)
p=(1,2)(12) q=(0)(0)
noconstant;
run;

outlier maxnum=132;
run;
forecast lead=12 out=fits1;
run;
*proc print data=fits1;
proc univariate data=fits1 normal;
var residual;
run;
```

Appendix 4. R Code for ANN Modeling

```
rm(list=ls()); library(neuralnet)
data=read.table("D:/Thesis/Inflow/01 Indonesia/Residual.txt",header=T)

n = 132 # in-sample size
l = 12  # out-of-sample size
p = 3   # maximum lag
h = 5   # number of hidden neuron

Z=data$a[1:n]
a=Z[(p+1):n]
a1=Z[p:(n-1)]
a2=Z[(p-1):(n-2)]
a3=Z[(p-2):(n-3)]

v=cbind(a,a1,a2,a3)
variables=2*(v-min(v))/(max(v)-min(v))-1
net = neuralnet(a~a1+a2+a3, variables, hidden=h, threshold=0.05, stepmax=3000,
      rep=500, learningrate.factor=list(minus=0.5,plus=1.2),algorithm="slr",
      err.fct="sse", act.fct="tanh", linear.output=TRUE);net

#===================================================================================

k = 468 # neuralnet best repetition

covariate=cbind(a1,a2,a3)
covariate=2*(covariate-min(v))/(max(v)-min(v))-1
fits=compute(net, covariate, rep=k)
fits=fits$net.result
fits=(fits+1)*(max(v)-min(v))/2+min(v)
rmse.in = sqrt(mean((data$a[(p+1):n]-fits)^2,na.rm=T))

forecasts=rep(0,l)
for(i in 1:l)
{
a1=Z[n-p-1+i]
a2=Z[n-p-2+i]
a3=Z[n-p-3+i]
covariate=cbind(a1,a2,a3)
covariate=2*(covariate-min(v))/(max(v)-min(v))-1
f=compute(net, covariate, rep=k)
f=f$net.result
forecasts[i]=(f+1)*(max(v)-min(v))/2+min(v)
Z[n-p+i]=forecasts[i]
}
rmse.out = sqrt(mean((forecasts[1:l]-data$a[(n+1):(n+l)])^2,na.rm=T))
performance=cbind(rmse.in,rmse.out);performance

plot(net,rep=k)
write.table(fits,"D:/Thesis/Inflow/01 Indonesia/net_fits.csv",sep=",",row.names=F,
col.names=F)
write.table(forecasts,"D:/ Thesis/Inflow/01 Indonesia/net_forecasts.csv",row.names=F,
col.names=F)
write.table(performance,"D:/ Thesis/Inflow/01 Indonesia/net_performance.csv",sep=",",
row.names=F,col.names=T)
```

Appendix 5. Parameter Estimates of the First Level ARIMAX Model for Currency Inflow

5.1 Indonesia

Parameter	Estimate	SE	T	p-value	Lag	Variable
AR1,1	0.4557	0.0977	4.67	<0.0001	1	Y
AR1,2	0.4103	0.0979	4.19	<0.0001	2	Y
AR2,1	0.8450	0.0715	11.82	<0.0001	12	Y
NUM1	306.4	121.1	2.53	0.0130	0	t
NUM2	-3929.0	3463.9	-1.13	0.2594	0	H24t
NUM3	15309.4	4371.9	3.50	0.0007	0	H13t
NUM4	24140.4	4731.2	5.10	<0.0001	0	H2t
NUM5	2069.6	3794.7	0.55	0.5867	0	H23t
NUM6	15377.2	4295.7	3.58	0.0005	0	H12t
NUM7	25986.2	4518.7	5.75	<0.0001	0	H0t
NUM8	4717.0	3633.4	1.30	0.1973	0	H19t
NUM9	24203.3	4817.4	5.02	<0.0001	0	H9t
NUM10	-5007.2	3705.6	-1.35	0.1797	0	H30t
NUM11	23887.9	4714.1	5.07	<0.0001	0	H18t
NUM12	55851.8	5281.3	10.58	<0.0001	0	H7t
NUM13	0.0	0.0	.	.	0	H27t
NUM14	23108.1	3297.7	7.01	<0.0001	0	H24tm1
NUM15	9799.4	3836.3	2.55	0.0122	0	H13tm1
NUM16	6729.0	3484.5	1.93	0.0564	0	H2tm1
NUM17	9290.9	5262.4	1.77	0.0806	0	H23tm1
NUM18	7135.6	4392.6	1.62	0.1075	0	H12tm1
NUM19	219.9	3556.6	0.06	0.9508	0	H0tm1
NUM20	16003.9	4283.0	3.74	0.0003	0	H19tm1
NUM21	1543.6	4006.1	0.39	0.7008	0	H9tm1
NUM22	44438.2	5248.8	8.47	<0.0001	0	H30tm1
NUM23	9661.6	5657.7	1.71	0.0909	0	H18tm1
NUM24	2649.3	5922.0	0.45	0.6556	0	H7tm1
NUM25	0.0	0.0	.	.	0	H27tm1
NUM26	-12109.6	4048.1	-2.99	0.0035	0	S48
NUM27	15453.8	3465.6	4.46	<0.0001	0	A95
NUM28	11413.7	3451.7	3.31	0.0013	0	A96
NUM29	-25265.1	3163.7	-7.99	<0.0001	0	A97
NUM30	-7048.5	2972.3	-2.37	0.0197	0	A98
NUM31	15228.3	3631.5	4.19	<0.0001	0	A121

5.2 Jakarta

Parameter	Estimate	SE	T	p-value	Lag	Variable
AR1,1	0.5836	0.0990	5.89	<.0001	1	Y
AR1,2	0.4912	0.1047	4.69	<.0001	3	Y
AR1,3	-0.1948	0.1086	-1.79	0.0759	4	Y
AR2,1	0.7194	0.0885	8.13	<.0001	12	Y
NUM1	66.1786	21.7729	3.04	0.0031	0	t
NUM2	-1342.1	790.1	-1.70	0.0926	0	H24t
NUM3	2921.2	925.6	3.16	0.0021	0	H13t
NUM4	4911.5	957.9	5.13	<.0001	0	H2t
NUM5	1754.5	770.5	2.28	0.0250	0	H23t
NUM6	4372.6	925.7	4.72	<.0001	0	H12t
NUM7	5281.8	977.0	5.41	<.0001	0	H0t
NUM8	2618.0	758.4	3.45	0.0008	0	H19t
NUM9	8860.1	971.9	9.12	<.0001	0	H9t
NUM10	-1433.8	810.1	-1.77	0.0799	0	H30t
NUM11	5537.2	959.5	5.77	<.0001	0	H18t
NUM12	13903.5	1042.3	13.34	<.0001	0	H7t
NUM13	0.0	0.0	.	.	0	H27t
NUM14	5477.1	771.6	7.10	<.0001	0	H24tm1
NUM15	1515.8	862.3	1.76	0.0820	0	H13tm1
NUM16	1370.2	750.9	1.82	0.0712	0	H2tm1
NUM17	1551.2	955.9	1.62	0.1079	0	H23tm1
NUM18	485.6	918.7	0.53	0.5983	0	H12tm1
NUM19	21.5	760.3	0.03	0.9775	0	H0tm1

NUM20	1073.8	900.0	1.19	0.2358	0	H19tm1
NUM21	1044.3	879.8	1.19	0.2382	0	H9tm1
NUM22	10214.9	1002.5	10.19	<.0001	0	H30tm1
NUM23	2330.9	1057.5	2.20	0.0299	0	H18tm1
NUM24	1394.4	1094.4	1.27	0.2057	0	H7tm1
NUM25	0.0	0.0	.	.	0	H27tm1
NUM26	-3190.5	652.5	-4.89	<.0001	0	S41
NUM27	3650.3	717.8	5.09	<.0001	0	A95
NUM28	3405.2	809.0	4.21	<.0001	0	A96
NUM29	-3861.9	694.2	-5.56	<.0001	0	A97
NUM30	3750.7	723.8	5.18	<.0001	0	A121
NUM31	2005.3	611.6	3.28	0.0015	0	A73
NUM32	2105.0	620.8	3.39	0.0010	0	A99

5.3 Sumatera

Parameter	Estimate	SE	T	p-value	Lag	Variable
AR1,1	0.4953	0.0965	5.13	<.0001	1	Y
AR1,2	0.3739	0.0977	3.83	0.0002	2	Y
AR1,3	-0.1310	0.0660	-1.98	0.0500	10	Y
AR2,1	0.7279	0.0886	8.22	<.0001	12	Y
NUM1	55.7591	12.4020	4.50	<.0001	0	t
NUM2	-431.3	789.9	-0.55	0.5863	0	H24t
NUM3	2451.3	957.8	2.56	0.0120	0	H13t
NUM4	4217.7	1011.9	4.17	<.0001	0	H2t
NUM5	1058.8	806.4	1.31	0.1922	0	H23t
NUM6	2799.5	942.1	2.97	0.0037	0	H12t
NUM7	5634.4	980.3	5.75	<.0001	0	H0t
NUM8	1048.7	809.2	1.30	0.1980	0	H19t
NUM9	2712.2	966.6	2.81	0.0060	0	H9t
NUM10	-227.7	820.6	-0.28	0.7820	0	H30t
NUM11	5706.6	985.8	5.79	<.0001	0	H18t
NUM12	9998.7	1063.1	9.41	<.0001	0	H7t
NUM13	0.0	0.0	.	.	0	H27t
NUM14	4099.6	757.2	5.41	<.0001	0	H24tm1
NUM15	2200.3	864.8	2.54	0.0125	0	H13tm1
NUM16	1868.5	795.7	2.35	0.0208	0	H2tm1
NUM17	2997.5	1007.8	2.97	0.0037	0	H23tm1
NUM18	425.9	949.8	0.45	0.6548	0	H12tm1
NUM19	-414.4	805.4	-0.51	0.6080	0	H0tm1
NUM20	2267.7	938.6	2.42	0.0175	0	H19tm1
NUM21	-1426.3	806.2	-1.77	0.0799	0	H9tm1
NUM22	8716.0	1052.1	8.28	<.0001	0	H30tm1
NUM23	2017.8	1093.4	1.85	0.0679	0	H18tm1
NUM24	139.5	1117.4	0.12	0.9009	0	H7tm1
NUM25	0.0	0.0	.	.	0	H27tm1
NUM26	-1957.6	722.8	-2.71	0.0080	0	S50
NUM27	-4601.7	617.9	-7.45	<.0001	0	A97
NUM28	3339.9	804.8	4.15	<.0001	0	A121

5.4 Jawa

Parameter	Estimate	SE	T	p-value	Lag	Variable
AR1,1	0.4640	0.0925	5.02	<.0001	1	Y
AR1,2	0.3961	0.0931	4.26	<.0001	3	Y
AR2,1	0.7572	0.0828	9.14	<.0001	12	Y
NUM1	154.6	38.3	4.04	0.0001	0	t
NUM2	-1614.0	1560.0	-1.03	0.3034	0	H24t
NUM3	6770.5	1911.4	3.54	0.0006	0	H13t
NUM4	10952.6	2017.4	5.43	<.0001	0	H2t
NUM5	1046.5	1641.9	0.64	0.5254	0	H23t
NUM6	5365.0	1875.7	2.86	0.0052	0	H12t
NUM7	10497.0	1948.9	5.39	<.0001	0	H0t
NUM8	1000.8	1551.7	0.64	0.5204	0	H19t
NUM9	10411.7	1966.3	5.30	<.0001	0	H9t
NUM10	-3823.5	1598.2	-2.39	0.0186	0	H30t
NUM11	5689.0	1974.2	2.88	0.0049	0	H18t
NUM12	23524.6	2170.8	10.84	<.0001	0	H7t

NUM13	0.0	0.0	.	.	0	H27t
NUM14	9414.3	1535.3	6.13	<.0001	0	H24tm1
NUM15	3840.5	1742.1	2.20	0.0298	0	H13tm1
NUM16	2056.6	1555.6	1.32	0.1892	0	H2tm1
NUM17	5636.1	2227.8	2.53	0.0130	0	H23tm1
NUM18	5215.5	1896.6	2.75	0.0071	0	H12tm1
NUM19	1069.5	1546.3	0.69	0.4908	0	H0tm1
NUM20	9537.3	1862.8	5.12	<.0001	0	H19tm1
NUM21	1748.0	1650.7	1.06	0.2922	0	H9tm1
NUM22	19869.2	2114.3	9.40	<.0001	0	H30tm1
NUM23	7926.0	2244.2	3.53	0.0006	0	H18tm1
NUM24	2355.8	2305.8	1.02	0.3094	0	H7tm1
NUM25	0.0	0.0	.	.	0	H27tm1
NUM26	4250.1	1207.3	3.52	0.0007	0	A1
NUM27	-6042.9	1514.3	-3.99	0.0001	0	S48
NUM28	9563.1	1342.9	7.12	<.0001	0	A95
NUM29	5382.6	1396.9	3.85	0.0002	0	A96
NUM30	-7975.6	1321.2	-6.04	<.0001	0	A97
NUM31	7208.7	1573.2	4.58	<.0001	0	A121

5.5 Balinusra

Parameter	Estimate	SE	T	p-value	Lag	Variable
AR1,1	0.4773	0.1002	4.76	<.0001	1	Y
AR1,2	0.3416	0.0985	3.47	0.0008	2	Y
AR2,1	0.8017	0.0746	10.75	<.0001	12	Y
NUM1	14.6	4.9	3.00	0.0035	0	t
NUM2	-114.3	213.1	-0.54	0.5927	0	H24t
NUM3	457.7	265.3	1.73	0.0876	0	H13t
NUM4	647.9	285.2	2.27	0.0253	0	H2t
NUM5	113.1	217.1	0.52	0.6036	0	H23t
NUM6	83.9	260.7	0.32	0.7482	0	H12t
NUM7	523.5	272.9	1.92	0.0580	0	H0t
NUM8	-80.1	218.1	-0.37	0.7142	0	H19t
NUM9	126.2	272.6	0.46	0.6443	0	H9t
NUM10	-27.5	221.1	-0.12	0.9012	0	H30t
NUM11	629.7	278.0	2.27	0.0257	0	H18t
NUM12	1491.5	307.3	4.85	<.0001	0	H7t
NUM13	0.0	0.0	.	.	0	H27t
NUM14	938.1	204.0	4.60	<.0001	0	H24tm1
NUM15	682.4	239.0	2.85	0.0052	0	H13tm1
NUM16	669.3	225.0	2.97	0.0037	0	H2tm1
NUM17	456.9	288.8	1.58	0.1169	0	H23tm1
NUM18	84.5	264.8	0.32	0.7502	0	H12tm1
NUM19	-171.9	215.8	-0.80	0.4277	0	H0tm1
NUM20	95.9	259.5	0.37	0.7126	0	H19tm1
NUM21	-428.1	215.3	-1.99	0.0495	0	H9tm1
NUM22	1189.1	304.4	3.91	0.0002	0	H30tm1
NUM23	148.1	323.6	0.46	0.6482	0	H18tm1
NUM24	-63.8	335.1	-0.19	0.8493	0	H7tm1
NUM25	0.0	0.0	.	.	0	H27tm1
NUM26	-619.7	199.5	-3.11	0.0025	0	S49
NUM27	1146.3	215.6	5.32	<.0001	0	A121
NUM28	-1441.5	167.8	-8.59	<.0001	0	A97
NUM29	-848.4	166.6	-5.09	<.0001	0	A98

5.6 Kalimantan

Parameter	Estimate	SE	T	p-value	Lag	Variable
AR1,1	0.8967	0.0449	19.96	<.0001	1	Y
AR2,1	0.9637	0.0590	16.35	<.0001	12	Y
NUM1	-313.0	204.7	-1.53	0.1294	0	H24t
NUM2	858.7	257.1	3.34	0.0012	0	H13t
NUM3	1398.7	274.2	5.10	<.0001	0	H2t
NUM4	293.2	208.5	1.41	0.1627	0	H23t
NUM5	859.2	259.6	3.31	0.0013	0	H12t
NUM6	1653.0	276.2	5.98	<.0001	0	H0t
NUM7	64.1	219.0	0.29	0.7703	0	H19t

NUM8	724.4	289.7	2.50	0.0140	0	H9t
NUM9	-251.3	225.3	-1.12	0.2673	0	H30t
NUM10	1650.1	324.6	5.08	<.0001	0	H18t
NUM11	3507.9	365.0	9.61	<.0001	0	H7t
NUM12	0.0	0.0	.	.	0	H27t
NUM13	1291.7	204.5	6.32	<.0001	0	H24tm1
NUM14	793.6	227.6	3.49	0.0007	0	H13tm1
NUM15	714.5	198.5	3.60	0.0005	0	H2tm1
NUM16	1262.8	271.3	4.65	<.0001	0	H23tm1
NUM17	337.5	257.0	1.31	0.1920	0	H12tm1
NUM18	193.1	208.2	0.93	0.3560	0	H0tm1
NUM19	1296.3	253.9	5.11	<.0001	0	H19tm1
NUM20	-280.8	208.2	-1.35	0.1804	0	H9tm1
NUM21	2663.2	358.2	7.44	<.0001	0	H30tm1
NUM22	949.5	410.5	2.31	0.0228	0	H18tm1
NUM23	-24.3	447.4	-0.05	0.9567	0	H7tm1
NUM24	0.0	0.0	.	.	0	H27tm1
NUM25	622.6	144.6	4.30	<.0001	0	A1
NUM26	-2011.2	155.6	-12.92	<.0001	0	A97
NUM27	-965.0	155.4	-6.21	<.0001	0	A98
NUM28	657.2	205.4	3.20	0.0018	0	A121
NUM29	678.5	164.2	4.13	<.0001	0	A115

5.7 Sulampua

Parameter	Estimate	SE	T	p-value	Lag	Variable
AR1,1	0.8453	0.0573	14.75	<.0001	1	Y
AR2,1	0.9656	0.0567	17.02	<.0001	12	Y
NUM1	27.5	12.6	2.18	0.0315	0	t
NUM2	-306.9	260.5	-1.18	0.2415	0	H24t
NUM3	517.8	326.9	1.58	0.1165	0	H13t
NUM4	1338.9	348.7	3.84	0.0002	0	H2t
NUM5	349.1	264.3	1.32	0.1897	0	H23t
NUM6	632.5	329.6	1.92	0.0579	0	H12t
NUM7	1551.0	351.1	4.42	<.0001	0	H0t
NUM8	138.6	278.2	0.50	0.6194	0	H19t
NUM9	871.2	370.5	2.35	0.0207	0	H9t
NUM10	-125.4	287.5	-0.44	0.6636	0	H30t
NUM11	1560.7	392.2	3.98	0.0001	0	H18t
NUM12	3750.4	465.9	8.05	<.0001	0	H7t
NUM13	0.0	0.0	.	.	0	H27t
NUM14	1359.8	260.5	5.22	<.0001	0	H24tm1
NUM15	1023.5	289.6	3.53	0.0006	0	H13tm1
NUM16	1081.4	251.8	4.29	<.0001	0	H2tm1
NUM17	1376.2	345.8	3.98	0.0001	0	H23tm1
NUM18	145.7	326.1	0.45	0.6561	0	H12tm1
NUM19	68.2	263.8	0.26	0.7965	0	H0tm1
NUM20	1091.9	323.1	3.38	0.0010	0	H19tm1
NUM21	-379.2	265.6	-1.43	0.1565	0	H9tm1
NUM22	3309.6	459.5	7.20	<.0001	0	H30tm1
NUM23	480.4	524.3	0.92	0.3618	0	H18tm1
NUM24	-326.0	576.9	-0.57	0.5734	0	H7tm1
NUM25	0.0	0.0	.	.	0	H27tm1
NUM26	-1097.0	231.4	-4.74	<.0001	0	S50
NUM27	847.8	184.6	4.59	<.0001	0	A1
NUM28	-3072.1	270.6	-11.35	<.0001	0	A97
NUM29	-1772.0	196.8	-9.00	<.0001	0	A98
NUM30	2458.9	465.6	5.28	<.0001	0	A121
NUM31	1152.3	370.3	3.11	0.0024	0	A109
NUM32	610.2	171.3	3.56	0.0006	0	A31

5.8 Jakarta

Parameter	Estimate	SE	T	p-value	Lag	Variable
AR1,1	0.5836	0.0990	5.89	<.0001	1	Y

AR1,2	0.4912	0.1047	4.69	<.0001	3	Y
AR1,3	-0.1948	0.1086	-1.79	0.0759	4	Y
AR2,1	0.7194	0.0885	8.13	<.0001	12	Y
NUM1	66.1786	21.7729	3.04	0.0031	0	t
NUM2	-1342.1	790.1	-1.70	0.0926	0	H24t
NUM3	2921.2	925.6	3.16	0.0021	0	H13t
NUM4	4911.5	957.9	5.13	<.0001	0	H2t
NUM5	1754.5	770.5	2.28	0.0250	0	H23t
NUM6	4372.6	925.7	4.72	<.0001	0	H12t
NUM7	5281.8	977.0	5.41	<.0001	0	H0t
NUM8	2618.0	758.4	3.45	0.0008	0	H19t
NUM9	8860.1	971.9	9.12	<.0001	0	H9t
NUM10	-1433.8	810.1	-1.77	0.0799	0	H30t
NUM11	5537.2	959.5	5.77	<.0001	0	H18t
NUM12	13903.5	1042.3	13.34	<.0001	0	H7t
NUM13	0.0	0.0	.	.	0	H27t
NUM14	5477.1	771.6	7.10	<.0001	0	H24tm1
NUM15	1515.8	862.3	1.76	0.0820	0	H13tm1
NUM16	1370.2	750.9	1.82	0.0712	0	H2tm1
NUM17	1551.2	955.9	1.62	0.1079	0	H23tm1
NUM18	485.6	918.7	0.53	0.5983	0	H12tm1
NUM19	21.5	760.3	0.03	0.9775	0	H0tm1
NUM20	1073.8	900.0	1.19	0.2358	0	H19tm1
NUM21	1044.3	879.8	1.19	0.2382	0	H9tm1
NUM22	10214.9	1002.5	10.19	<.0001	0	H30tm1
NUM23	2330.9	1057.5	2.20	0.0299	0	H18tm1
NUM24	1394.4	1094.4	1.27	0.2057	0	H7tm1
NUM25	0.0	0.0	.	.	0	H27tm1
NUM26	-3190.5	652.5	-4.89	<.0001	0	S41
NUM27	3650.3	717.8	5.09	<.0001	0	A95
NUM28	3405.2	809.0	4.21	<.0001	0	A96
NUM29	-3861.9	694.2	-5.56	<.0001	0	A97
NUM30	3750.7	723.8	5.18	<.0001	0	A121
NUM31	2005.3	611.6	3.28	0.0015	0	A73
NUM32	2105.0	620.8	3.39	0.0010	0	A99

5.9 Aceh

Parameter	Estimate	SE	T	p-value	Lag	Variable
MA1,1	0.4032	0.1180	3.42	0.0009	2	Y
AR1,1	0.9152	0.0496	18.46	<.0001	1	Y
AR2,1	0.3079	0.1288	2.39	0.0188	12	Y
NUM1	3.1	0.6	5.52	<.0001	0	t
NUM2	-31.9	41.6	-0.77	0.4450	0	H24t
NUM3	42.5	43.6	0.98	0.3319	0	H13t
NUM4	87.1	42.2	2.06	0.0417	0	H2t
NUM5	21.6	42.2	0.51	0.6092	0	H23t
NUM6	117.8	42.9	2.75	0.0071	0	H12t
NUM7	204.5	42.1	4.86	<.0001	0	H0t
NUM8	33.7	41.0	0.82	0.4133	0	H19t
NUM9	72.4	42.0	1.72	0.0879	0	H9t
NUM10	26.1	41.3	0.63	0.5290	0	H30t
NUM11	111.8	43.4	2.58	0.0114	0	H18t
NUM12	242.0	43.4	5.57	<.0001	0	H7t
NUM13	0.0	0.0	.	.	0	H27t
NUM14	66.1	44.7	1.48	0.1427	0	H24tm1
NUM15	117.5	44.5	2.64	0.0097	0	H13tm1
NUM16	-8.0	41.3	-0.19	0.8470	0	H2tm1
NUM17	162.1	43.9	3.70	0.0004	0	H23tm1
NUM18	8.7	42.8	0.20	0.8391	0	H12tm1
NUM19	4.5	41.0	0.11	0.9136	0	H0tm1
NUM20	13.8	42.0	0.33	0.7438	0	H19tm1
NUM21	-1.6	42.1	-0.04	0.9706	0	H9tm1
NUM22	243.3	42.2	5.77	<.0001	0	H30tm1
NUM23	72.7	44.9	1.62	0.1089	0	H18tm1
NUM24	-67.9	43.6	-1.56	0.1223	0	H7tm1
NUM25	0.0	0.0	.	.	0	H27tm1

NUM26	-187.1	40.3	-4.64	<.0001	0	S50
NUM27	244.8	32.2	7.60	<.0001	0	A121
NUM28	130.4	28.5	4.57	<.0001	0	A29
NUM29	-97.0	29.3	-3.31	0.0013	0	A97
NUM30	92.8	33.5	2.77	0.0067	0	A119

5.10 Lhokseumawe

Parameter	Estimate	SE	T	p-value	Lag	Variable
MA1,1	-0.3764	0.0971	-3.88	0.0002	1	Y
AR1,1	0.6515	0.0803	8.11	<.0001	2	Y
AR2,1	0.5724	0.1036	5.53	<.0001	12	Y
NUM1	1.4	0.3	4.16	<.0001	0	t
NUM2	-23.4	24.4	-0.96	0.3409	0	H24t
NUM3	20.9	27.4	0.76	0.4472	0	H13t
NUM4	46.5	28.2	1.65	0.1015	0	H2t
NUM5	14.0	26.5	0.53	0.5983	0	H23t
NUM6	29.1	27.3	1.07	0.2887	0	H12t
NUM7	158.9	27.9	5.69	<.0001	0	H0t
NUM8	-12.9	24.5	-0.53	0.5994	0	H19t
NUM9	1.0	27.5	0.04	0.9711	0	H9t
NUM10	28.1	24.5	1.15	0.2534	0	H30t
NUM11	136.6	27.4	4.98	<.0001	0	H18t
NUM12	316.9	28.4	11.15	<.0001	0	H7t
NUM13	0.0	0.0	.	.	0	H27t
NUM14	68.7	23.9	2.87	0.0049	0	H24tm1
NUM15	8.9	26.4	0.34	0.7367	0	H13tm1
NUM16	39.1	24.6	1.59	0.1146	0	H2tm1
NUM17	10.9	32.3	0.34	0.7366	0	H23tm1
NUM18	0.6	27.3	0.02	0.9830	0	H12tm1
NUM19	-13.7	24.4	-0.56	0.5756	0	H0tm1
NUM20	71.2	27.2	2.62	0.0102	0	H19tm1
NUM21	7.1	24.4	0.29	0.7712	0	H9tm1
NUM22	208.6	28.4	7.36	<.0001	0	H30tm1
NUM23	21.6	28.6	0.75	0.4520	0	H18tm1
NUM24	-39.6	28.8	-1.37	0.1729	0	H7tm1
NUM25	0.0	0.0	.	.	0	H27tm1
NUM26	-94.6	28.0	-3.38	0.0010	0	S48
NUM27	70.9	20.8	3.41	0.0009	0	A1

5.11 Sumatera Utara

Parameter	Estimate	SE	T	p-value	Lag	Variable
AR1,1	0.4980	0.0911	5.46	<.0001	1	Y
AR1,2	0.3791	0.0922	4.11	<.0001	3	Y
AR2,1	0.4244	0.1071	3.96	0.0001	12	Y
NUM1	13.1	4.1	3.15	0.0021	0	t
NUM2	-251.2	293.6	-0.86	0.3943	0	H24t
NUM3	513.3	315.5	1.63	0.1069	0	H13t
NUM4	1052.8	315.6	3.34	0.0012	0	H2t
NUM5	403.9	293.4	1.38	0.1717	0	H23t
NUM6	385.6	314.3	1.23	0.2228	0	H12t
NUM7	1409.8	315.6	4.47	<.0001	0	H0t
NUM8	469.8	290.2	1.62	0.1086	0	H19t
NUM9	477.1	313.7	1.52	0.1314	0	H9t
NUM10	-272.3	292.2	-0.93	0.3537	0	H30t
NUM11	976.4	316.6	3.08	0.0026	0	H18t
NUM12	2185.6	319.4	6.84	<.0001	0	H7t
NUM13	0.0	0.0	.	.	0	H27t
NUM14	954.9	297.0	3.21	0.0018	0	H24tm1
NUM15	310.8	314.5	0.99	0.3254	0	H13tm1
NUM16	222.2	290.3	0.77	0.4458	0	H2tm1
NUM17	1136.6	316.3	3.59	0.0005	0	H23tm1
NUM18	323.2	314.1	1.03	0.3060	0	H12tm1
NUM19	253.1	290.0	0.87	0.3850	0	H0tm1
NUM20	1479.2	315.5	4.69	<.0001	0	H19tm1
NUM21	337.0	315.8	1.07	0.2886	0	H9tm1
NUM22	1950.7	316.0	6.17	<.0001	0	H30tm1

NUM23	564.6	322.2	1.75	0.0827	0	H18tm1
NUM24	158.8	320.1	0.50	0.6209	0	H7tm1
NUM25	0.0	0.0	.	.	0	H27tm1
NUM26	1283.1	270.4	4.75	<.0001	0	A95
NUM27	-1040.3	266.7	-3.90	0.0002	0	A97
NUM28	1023.1	284.3	3.60	0.0005	0	A121

5.12 Sibolga

Parameter	Estimate	SE	T	p-value	Lag	Variable
MA1,1	-0.4195	0.1091	-3.85	0.0002	1	Y
AR1,1	0.6499	0.0837	7.77	<.0001	2	Y
AR1,2	0.1536	0.0813	1.89	0.0619	3	Y
AR2,1	0.9967	0.0664	15.02	<.0001	12	Y
NUM1	0.6	0.8	0.75	0.4532	0	t
NUM2	-9.8	12.9	-0.76	0.4503	0	H24t
NUM3	42.2	16.7	2.53	0.0131	0	H13t
NUM4	89.2	18.2	4.89	<.0001	0	H2t
NUM5	49.2	13.5	3.64	0.0004	0	H23t
NUM6	35.0	16.5	2.12	0.0369	0	H12t
NUM7	34.4	17.5	1.96	0.0524	0	H0t
NUM8	-10.4	14.9	-0.70	0.4860	0	H19t
NUM9	-4.5	20.3	-0.22	0.8252	0	H9t
NUM10	10.7	15.0	0.72	0.4753	0	H30t
NUM11	80.6	20.3	3.98	0.0001	0	H18t
NUM12	171.6	24.6	6.97	<.0001	0	H7t
NUM13	0.0	0.0	.	.	0	H27t
NUM14	71.0	12.1	5.87	<.0001	0	H24tm1
NUM15	44.1	14.2	3.11	0.0025	0	H13tm1
NUM16	28.7	12.7	2.27	0.0254	0	H2tm1
NUM17	113.2	18.4	6.16	<.0001	0	H23tm1
NUM18	28.2	17.0	1.66	0.1007	0	H12tm1
NUM19	6.8	14.3	0.47	0.6369	0	H0tm1
NUM20	8.4	16.6	0.51	0.6117	0	H19tm1
NUM21	-11.4	13.6	-0.84	0.4026	0	H9tm1
NUM22	54.9	24.6	2.23	0.0279	0	H30tm1
NUM23	20.7	28.2	0.74	0.4637	0	H18tm1
NUM24	19.0	31.3	0.61	0.5462	0	H7tm1
NUM25	0.0	0.0	.	.	0	H27tm1
NUM26	143.3	15.5	9.26	<.0001	0	A121
NUM27	-130.5	9.8	-13.26	<.0001	0	A97
NUM28	34.9	10.4	3.36	0.0011	0	A73
NUM29	-32.0	10.1	-3.18	0.0020	0	A41
NUM30	-32.3	9.8	-3.29	0.0014	0	A98

5.13 Pematang Siantar

Parameter	Estimate	SE	T	p-value	Lag	Variable
AR1,1	0.5111	0.2616	1.95	0.0673	1	Y
AR2,1	0.5154	0.2817	1.83	0.0849	12	Y
NUM1	1.0432	0.2731	3.82	0.0014	0	t
NUM2	0.0	0.0	.	.	0	H24t
NUM3	0.0	0.0	.	.	0	H13t
NUM4	0.0	0.0	.	.	0	H2t
NUM5	0.0	0.0	.	.	0	H23t
NUM6	0.0	0.0	.	.	0	H12t
NUM7	0.0	0.0	.	.	0	H0t
NUM8	0.0	0.0	.	.	0	H19t
NUM9	110.2	62.6	1.76	0.0964	0	H9t
NUM10	-36.2	66.0	-0.55	0.5900	0	H30t
NUM11	186.6	80.6	2.31	0.0334	0	H18t
NUM12	536.7	74.9	7.16	<.0001	0	H7t
NUM13	0.0	0.0	.	.	0	H27t
NUM14	0.0	0.0	.	.	0	H24tm1
NUM15	0.0	0.0	.	.	0	H13tm1
NUM16	0.0	0.0	.	.	0	H2tm1
NUM17	0.0	0.0	.	.	0	H23tm1
NUM18	0.0	0.0	.	.	0	H12tm1

NUM19	0.0	0.0	.	.	0	H0tm1
NUM20	0.0	0.0	.	.	0	H19tm1
NUM21	-32.0	56.4	-0.57	0.5786	0	H9tm1
NUM22	430.1	70.0	6.15	<.0001	0	H30tm1
NUM23	54.8	76.3	0.72	0.4824	0	H18tm1
NUM24	-0.9	74.2	-0.01	0.9899	0	H7tm1
NUM25	0.0	0.0	.	.	0	H27tm1
NUM26	287.0	67.5	4.25	0.0005	0	A121
NUM27	238.5	59.9	3.98	0.0010	0	A109

5.14 Bengkulu

Parameter	Estimate	SE	T	p-value	Lag	Variable
AR1,1	0.8155	0.0606	13.45	<.0001	1	Y
AR2,1	0.9762	0.0519	18.80	<.0001	12	Y
NUM1	-19.6	24.5	-0.80	0.4245	0	H24t
NUM2	116.8	31.1	3.75	0.0003	0	H13t
NUM3	144.1	33.3	4.33	<.0001	0	H2t
NUM4	34.9	25.2	1.38	0.1699	0	H23t
NUM5	98.2	31.4	3.12	0.0023	0	H12t
NUM6	192.2	33.5	5.74	<.0001	0	H0t
NUM7	-4.7	26.6	-0.18	0.8598	0	H19t
NUM8	106.8	35.5	3.01	0.0034	0	H9t
NUM9	0.2	27.4	0.01	0.9955	0	H30t
NUM10	168.9	37.6	4.49	<.0001	0	H18t
NUM11	573.3	45.4	12.64	<.0001	0	H7t
NUM12	0.0	0.0	.	.	0	H27t
NUM13	207.2	23.1	8.96	<.0001	0	H24tm1
NUM14	121.9	26.9	4.54	<.0001	0	H13tm1
NUM15	108.1	23.7	4.55	<.0001	0	H2tm1
NUM16	140.0	33.1	4.23	<.0001	0	H23tm1
NUM17	-1.7	31.1	-0.05	0.9577	0	H12tm1
NUM18	-5.2	25.1	-0.21	0.8354	0	H0tm1
NUM19	102.0	30.8	3.31	0.0013	0	H19tm1
NUM20	-40.8	25.2	-1.62	0.1078	0	H9tm1
NUM21	352.6	44.2	7.97	<.0001	0	H30tm1
NUM22	103.8	50.6	2.05	0.0427	0	H18tm1
NUM23	12.8	56.0	0.23	0.8189	0	H7tm1
NUM24	0.0	0.0	.	.	0	H27tm1
NUM25	132.8	25.6	5.19	<.0001	0	A121
NUM26	-129.8	16.4	-7.92	<.0001	0	A97
NUM27	-38.5	20.4	-1.89	0.0621	0	A61
NUM28	71.7	19.3	3.72	0.0003	0	A73
NUM29	-87.6	19.9	-4.39	<.0001	0	A120
NUM30	-85.7	22.7	-3.77	0.0003	0	S50
NUM31	64.1	21.0	3.05	0.0029	0	S119

5.15 Jambi

Parameter	Estimate	SE	T	p-value	Lag	Variable
MA1,1	-0.7626	0.1158	-6.58	<.0001	6	Y
AR1,1	0.8082	0.0654	12.35	<.0001	1	Y
AR2,1	0.6712	0.1442	4.65	<.0001	12	Y
NUM1	4.6	0.8	5.84	<.0001	0	t
NUM2	-77.5	21.0	-3.69	0.0004	0	H24t
NUM3	101.2	21.1	4.80	<.0001	0	H13t
NUM4	168.5	21.1	8.00	<.0001	0	H2t
NUM5	54.8	24.7	2.21	0.0292	0	H23t
NUM6	138.3	21.2	6.51	<.0001	0	H12t
NUM7	254.3	21.1	12.07	<.0001	0	H0t
NUM8	-11.9	20.9	-0.57	0.5701	0	H19t
NUM9	212.9	24.0	8.88	<.0001	0	H9t
NUM10	-47.8	22.0	-2.17	0.0323	0	H30t
NUM11	226.3	24.6	9.19	<.0001	0	H18t
NUM12	580.6	28.6	20.28	<.0001	0	H7t
NUM13	0.0	0.0	.	.	0	H27t
NUM14	128.5	21.8	5.88	<.0001	0	H24tm1
NUM15	59.4	21.7	2.74	0.0074	0	H13tm1

NUM16	14.8	21.2	0.70	0.4860	0	H2tm1
NUM17	67.1	32.9	2.04	0.0447	0	H23tm1
NUM18	5.4	21.0	0.25	0.7995	0	H12tm1
NUM19	-3.3	20.9	-0.16	0.8738	0	H0tm1
NUM20	134.6	21.0	6.39	<.0001	0	H19tm1
NUM21	-43.8	21.0	-2.09	0.0397	0	H9tm1
NUM22	501.6	24.2	20.75	<.0001	0	H30tm1
NUM23	4.4	26.5	0.17	0.8686	0	H18tm1
NUM24	-63.4	27.6	-2.30	0.0237	0	H7tm1
NUM25	0.0	0.0	.	.	0	H27tm1
NUM26	-260.1	38.6	-6.73	<.0001	0	S48
NUM27	-83.6	24.4	-3.43	0.0009	0	S97
NUM28	96.1	18.4	5.24	<.0001	0	A1
NUM29	131.7	18.2	7.25	<.0001	0	A49
NUM30	105.3	18.2	5.79	<.0001	0	A73
NUM31	158.3	24.0	6.60	<.0001	0	A99
NUM32	71.7	18.4	3.90	0.0002	0	A107
NUM33	57.3	20.0	2.87	0.0051	0	A109
NUM34	-123.2	23.6	-5.22	<.0001	0	A118
NUM35	183.3	20.8	8.82	<.0001	0	A121

5.16 Sumatera Barat

Parameter	Estimate	SE	T	p-value	Lag	Variable
MA1,1	-0.2882	0.1048	-2.75	0.0071	3	Y
AR1,1	0.3146	0.0941	3.34	0.0012	1	Y
AR1,2	0.3204	0.0960	3.34	0.0012	5	Y
AR2,1	0.5383	0.0986	5.46	<.0001	12	Y
NUM1	7.1	1.5	4.85	<.0001	0	t
NUM2	-49.0	189.2	-0.26	0.7962	0	H24t
NUM3	176.0	213.9	0.82	0.4125	0	H13t
NUM4	654.8	217.4	3.01	0.0033	0	H2t
NUM5	65.1	189.4	0.34	0.7319	0	H23t
NUM6	288.6	214.5	1.35	0.1815	0	H12t
NUM7	845.1	217.3	3.89	0.0002	0	H0t
NUM8	195.6	188.8	1.04	0.3025	0	H19t
NUM9	742.6	216.4	3.43	0.0009	0	H9t
NUM10	-370.5	189.3	-1.96	0.0530	0	H30t
NUM11	229.2	217.1	1.06	0.2936	0	H18t
NUM12	1275.2	231.2	5.52	<.0001	0	H7t
NUM13	0.0	0.0	.	.	0	H27t
NUM14	541.1	189.2	2.86	0.0051	0	H24tm1
NUM15	212.8	208.0	1.02	0.3085	0	H13tm1
NUM16	125.9	188.1	0.67	0.5048	0	H2tm1
NUM17	721.1	217.7	3.31	0.0013	0	H23tm1
NUM18	87.3	214.0	0.41	0.6842	0	H12tm1
NUM19	-122.3	190.1	-0.64	0.5214	0	H0tm1
NUM20	188.2	210.7	0.89	0.3740	0	H19tm1
NUM21	-47.3	191.4	-0.25	0.8053	0	H9tm1
NUM22	1564.8	219.3	7.14	<.0001	0	H30tm1
NUM23	922.9	228.5	4.04	0.0001	0	H18tm1
NUM24	495.2	238.1	2.08	0.0400	0	H7tm1
NUM25	0.0	0.0	.	.	0	H27tm1

5.17 Riau

Parameter	Estimate	SE	T	p-value	Lag	Variable
MA1,1	-0.5004	0.1153	-4.34	<.0001	6	Y
AR1,1	0.6538	0.0870	7.52	<.0001	1	Y
AR2,1	0.6874	0.1013	6.78	<.0001	12	Y
NUM1	5.1	0.8	6.03	<.0001	0	t
NUM2	-127.5	40.8	-3.13	0.0023	0	H24t
NUM3	203.3	43.3	4.70	<.0001	0	H13t
NUM4	522.4	44.0	11.86	<.0001	0	H2t
NUM5	60.2	43.7	1.38	0.1716	0	H23t
NUM6	510.6	43.8	11.64	<.0001	0	H12t
NUM7	734.3	44.1	16.67	<.0001	0	H0t
NUM8	-10.1	39.8	-0.25	0.7999	0	H19t

NUM9	741.6	45.3	16.36	<.0001	0	H9t
NUM10	-166.2	41.6	-3.99	0.0001	0	H30t
NUM11	382.8	47.1	8.13	<.0001	0	H18t
NUM12	1054.0	53.3	19.78	<.0001	0	H7t
NUM13	0.0	0.0	.	.	0	H27t
NUM14	251.9	41.0	6.15	<.0001	0	H24tm1
NUM15	84.7	42.4	2.00	0.0485	0	H13tm1
NUM16	-52.0	41.1	-1.27	0.2088	0	H2tm1
NUM17	-187.1	54.2	-3.45	0.0008	0	H23tm1
NUM18	34.7	43.0	0.81	0.4212	0	H12tm1
NUM19	3.9	39.9	0.10	0.9219	0	H0tm1
NUM20	191.8	42.6	4.50	<.0001	0	H19tm1
NUM21	-106.2	40.1	-2.65	0.0094	0	H9tm1
NUM22	709.6	47.0	15.10	<.0001	0	H30tm1
NUM23	57.2	46.5	1.23	0.2218	0	H18tm1
NUM24	-51.8	50.9	-1.02	0.3122	0	H7tm1
NUM25	0.0	0.0	.	.	0	H27tm1
NUM26	-443.3	49.7	-8.93	<.0001	0	S48
NUM27	170.6	35.8	4.76	<.0001	0	A49
NUM28	329.5	39.7	8.31	<.0001	0	A1
NUM29	209.2	42.1	4.96	<.0001	0	S2
NUM30	-251.6	47.2	-5.33	<.0001	0	S131
NUM31	439.5	43.5	10.10	<.0001	0	A121
NUM32	173.3	36.8	4.71	<.0001	0	A99
NUM33	171.1	39.6	4.32	<.0001	0	A109

5.18 Kepulauan Riau

Parameter	Estimate	SE	T	p-value	Lag	Variable
MA1,1	0.4352	0.1124	3.87	0.0002	4	Y
AR1,1	0.7460	0.0830	8.99	<.0001	1	Y
AR1,2	0.2155	0.0845	2.55	0.0122	3	Y
AR2,1	0.3620	0.1173	3.09	0.0026	12	Y
NUM1	2.4	0.8	2.92	0.0043	0	t
NUM2	-65.7	31.4	-2.09	0.0388	0	H24t
NUM3	85.2	32.9	2.59	0.0110	0	H13t
NUM4	225.1	32.9	6.85	<.0001	0	H2t
NUM5	19.0	31.8	0.60	0.5510	0	H23t
NUM6	160.6	32.7	4.91	<.0001	0	H12t
NUM7	173.2	32.4	5.34	<.0001	0	H0t
NUM8	17.4	32.8	0.53	0.5966	0	H19t
NUM9	162.4	32.8	4.96	<.0001	0	H9t
NUM10	-65.5	31.9	-2.05	0.0426	0	H30t
NUM11	113.5	32.8	3.46	0.0008	0	H18t
NUM12	222.0	33.8	6.56	<.0001	0	H7t
NUM13	0.0	0.0	.	.	0	H27t
NUM14	139.7	32.0	4.36	<.0001	0	H24tm1
NUM15	21.3	32.7	0.65	0.5167	0	H13tm1
NUM16	45.6	32.6	1.40	0.1644	0	H2tm1
NUM17	139.4	32.6	4.27	<.0001	0	H23tm1
NUM18	0.9	32.5	0.03	0.9768	0	H12tm1
NUM19	-4.1	31.4	-0.13	0.8955	0	H0tm1
NUM20	157.8	32.3	4.89	<.0001	0	H19tm1
NUM21	-42.2	31.5	-1.34	0.1827	0	H9tm1
NUM22	237.4	32.9	7.22	<.0001	0	H30tm1
NUM23	70.1	32.9	2.13	0.0356	0	H18tm1
NUM24	14.0	35.3	0.40	0.6936	0	H7tm1
NUM25	0.0	0.0	.	.	0	H27tm1
NUM26	114.6	26.0	4.41	<.0001	0	A1
NUM27	-157.8	33.3	-4.74	<.0001	0	S41

5.19 Sumatera Selatan

Parameter	Estimate	SE	T	p-value	Lag	Variable
MA1,1	-0.0482	0.1423	-0.34	0.7354	2	Y
AR1,1	0.3757	0.0990	3.79	0.0003	1	Y
AR1,2	0.5078	0.1199	4.24	<.0001	2	Y
AR2,1	0.5798	0.0994	5.83	<.0001	12	Y

NUM1	8.5	2.4	3.57	0.0006	0	t
NUM2	-94.1	98.2	-0.96	0.3401	0	H24t
NUM3	210.4	112.9	1.86	0.0653	0	H13t
NUM4	353.2	117.1	3.02	0.0033	0	H2t
NUM5	56.6	112.6	0.50	0.6167	0	H23t
NUM6	690.3	111.2	6.21	<.0001	0	H12t
NUM7	889.6	113.6	7.83	<.0001	0	H0t
NUM8	252.2	98.7	2.55	0.0122	0	H19t
NUM9	552.5	111.3	4.96	<.0001	0	H9t
NUM10	-123.9	99.1	-1.25	0.2140	0	H30t
NUM11	1142.7	111.4	10.26	<.0001	0	H18t
NUM12	1427.0	123.4	11.57	<.0001	0	H7t
NUM13	0.0	0.0	.	.	0	H27t
NUM14	386.2	97.5	3.96	0.0001	0	H24tm1
NUM15	51.1	108.2	0.47	0.6377	0	H13tm1
NUM16	33.0	100.8	0.33	0.7441	0	H2tm1
NUM17	154.3	136.3	1.13	0.2603	0	H23tm1
NUM18	25.0	111.5	0.22	0.8230	0	H12tm1
NUM19	-164.0	98.6	-1.66	0.0994	0	H0tm1
NUM20	266.4	111.8	2.38	0.0191	0	H19tm1
NUM21	-159.6	98.3	-1.62	0.1075	0	H9tm1
NUM22	1179.5	115.6	10.20	<.0001	0	H30tm1
NUM23	156.6	116.5	1.34	0.1820	0	H18tm1
NUM24	-163.6	118.4	-1.38	0.1703	0	H7tm1
NUM25	0.0	0.0	.	.	0	H27tm1
NUM26	-527.1	129.3	-4.08	<.0001	0	S48
NUM27	-215.0	83.0	-2.59	0.0111	0	A98
NUM28	497.5	97.2	5.12	<.0001	0	A121
NUM29	-507.4	83.5	-6.08	<.0001	0	A97
NUM30	414.3	106.2	3.90	0.0002	0	A130

5.20 Lampung

Parameter	Estimate	SE	T	p-value	Lag	Variable
AR1,1	0.8070	0.0601	13.42	<.0001	1	Y
AR2,1	0.5451	0.0991	5.50	<.0001	12	Y
NUM1	3.9	1.6	2.47	0.0151	0	t
NUM2	-81.4	134.0	-0.61	0.5451	0	H24t
NUM3	353.8	151.0	2.34	0.0211	0	H13t
NUM4	641.8	151.6	4.23	<.0001	0	H2t
NUM5	229.3	136.1	1.68	0.0952	0	H23t
NUM6	500.5	151.6	3.30	0.0013	0	H12t
NUM7	1074.2	151.5	7.09	<.0001	0	H0t
NUM8	129.1	136.5	0.95	0.3463	0	H19t
NUM9	431.8	155.5	2.78	0.0065	0	H9t
NUM10	-14.3	136.6	-0.10	0.9171	0	H30t
NUM11	652.2	153.0	4.26	<.0001	0	H18t
NUM12	1003.2	157.5	6.37	<.0001	0	H7t
NUM13	0.0	0.0	.	.	0	H27t
NUM14	535.4	135.4	3.95	0.0001	0	H24tm1
NUM15	231.9	148.7	1.56	0.1220	0	H13tm1
NUM16	205.1	135.1	1.52	0.1321	0	H2tm1
NUM17	476.3	152.0	3.13	0.0022	0	H23tm1
NUM18	229.1	150.7	1.52	0.1316	0	H12tm1
NUM19	129.6	134.9	0.96	0.3388	0	H0tm1
NUM20	75.3	147.2	0.51	0.6102	0	H19tm1
NUM21	-77.3	157.9	-0.49	0.6256	0	H9tm1
NUM22	1216.6	154.7	7.86	<.0001	0	H30tm1
NUM23	486.9	158.4	3.07	0.0027	0	H18tm1
NUM24	57.5	159.1	0.36	0.7184	0	H7tm1
NUM25	0.0	0.0	.	.	0	H27tm1
NUM26	1018.0	136.6	7.45	<.0001	0	A121
NUM27	676.3	120.4	5.62	<.0001	0	A109
NUM28	440.9	124.2	3.55	0.0006	0	A95

5.21 Jawa Barat

Parameter	Estimate	SE	T	p-value	Lag	Variable
MA1,1	-0.1410	0.0926	-1.52	0.1311	1	Y
MA1,2	-0.7870	0.0906	-8.69	<.0001	5	Y
AR1,1	0.7609	0.0911	8.35	<.0001	2	Y
AR2,1	0.9459	0.0968	9.77	<.0001	12	Y
NUM1	41.9	16.5	2.55	0.0126	0	t
NUM2	-383.9	278.3	-1.38	0.1710	0	H24t
NUM3	1131.3	348.7	3.24	0.0016	0	H13t
NUM4	1726.5	358.1	4.82	<.0001	0	H2t
NUM5	-139.1	328.7	-0.42	0.6730	0	H23t
NUM6	49.7	319.7	0.16	0.8769	0	H12t
NUM7	2783.3	345.5	8.06	<.0001	0	H0t
NUM8	514.3	355.5	1.45	0.1514	0	H19t
NUM9	2386.8	458.4	5.21	<.0001	0	H9t
NUM10	-796.4	370.8	-2.15	0.0344	0	H30t
NUM11	1980.4	437.3	4.53	<.0001	0	H18t
NUM12	4725.2	536.2	8.81	<.0001	0	H7t
NUM13	0.0	0.0	.	.	0	H27t
NUM14	1695.6	193.0	8.78	<.0001	0	H24tm1
NUM15	361.8	246.9	1.47	0.1462	0	H13tm1
NUM16	-404.8	259.1	-1.56	0.1217	0	H2tm1
NUM17	621.2	385.0	1.61	0.1101	0	H23tm1
NUM18	1759.3	330.0	5.33	<.0001	0	H12tm1
NUM19	259.5	332.6	0.78	0.4373	0	H0tm1
NUM20	2055.0	330.7	6.21	<.0001	0	H19tm1
NUM21	-208.7	363.1	-0.57	0.5668	0	H9tm1
NUM22	4568.9	524.2	8.72	<.0001	0	H30tm1
NUM23	751.6	609.8	1.23	0.2209	0	H18tm1
NUM24	987.3	723.6	1.36	0.1758	0	H7tm1
NUM25	0.0	0.0	.	.	0	H27tm1
NUM26	992.4	212.7	4.66	<.0001	0	A1
NUM27	2427.6	219.5	11.06	<.0001	0	A13
NUM28	-1789.6	384.5	-4.65	<.0001	0	S48
NUM29	1069.0	296.2	3.61	0.0005	0	A49
NUM30	-1823.7	273.8	-6.66	<.0001	0	A97
NUM31	1511.1	272.0	5.56	<.0001	0	A73
NUM32	-1229.0	306.5	-4.01	0.0001	0	A98
NUM33	1124.1	268.2	4.19	<.0001	0	A68
NUM34	1475.9	284.0	5.20	<.0001	0	A95
NUM35	-996.6	274.2	-3.63	0.0005	0	A86
NUM36	1320.0	297.5	4.44	<.0001	0	A96

5.22 Tasikmalaya

Parameter	Estimate	SE	T	p-value	Lag	Variable
AR1,1	0.6180	0.1162	5.32	<.0001	1	Y
AR1,2	0.3973	0.1319	3.01	0.0033	2	Y
AR1,3	-0.0774	0.1195	-0.65	0.5190	3	Y
AR2,1	0.3025	0.1208	2.51	0.0139	12	Y
NUM1	12.3	2.2	5.47	<.0001	0	t
NUM2	-164.7	71.0	-2.32	0.0225	0	H24t
NUM3	324.7	71.9	4.52	<.0001	0	H13t
NUM4	412.5	71.7	5.76	<.0001	0	H2t
NUM5	193.3	82.4	2.35	0.0210	0	H23t
NUM6	329.6	72.5	4.55	<.0001	0	H12t
NUM7	171.7	72.3	2.37	0.0196	0	H0t
NUM8	21.5	69.6	0.31	0.7583	0	H19t
NUM9	148.8	72.0	2.07	0.0415	0	H9t
NUM10	-52.2	70.9	-0.74	0.4633	0	H30t
NUM11	385.3	72.7	5.30	<.0001	0	H18t
NUM12	505.9	72.3	7.00	<.0001	0	H7t
NUM13	0.0	0.0	.	.	0	H27t
NUM14	452.8	72.2	6.27	<.0001	0	H24tm1
NUM15	52.7	72.4	0.73	0.4683	0	H13tm1
NUM16	-110.4	69.5	-1.59	0.1156	0	H2tm1
NUM17	168.7	99.6	1.69	0.0937	0	H23tm1
NUM18	89.3	72.0	1.24	0.2176	0	H12tm1

NUM19	145.6	69.0	2.11	0.0375	0	H0tm1
NUM20	173.9	71.4	2.44	0.0167	0	H19tm1
NUM21	-113.7	69.4	-1.64	0.1048	0	H9tm1
NUM22	708.3	73.0	9.71	<.0001	0	H30tm1
NUM23	217.6	72.6	3.00	0.0035	0	H18tm1
NUM24	-70.5	72.2	-0.98	0.3315	0	H7tm1
NUM25	0.0	0.0	.	.	0	H27tm1
NUM26	308.3	66.1	4.67	<.0001	0	A1
NUM27	-439.8	115.3	-3.81	0.0002	0	S48
NUM28	276.9	71.0	3.90	0.0002	0	A121
NUM29	-399.9	76.3	-5.24	<.0001	0	S97
NUM30	227.7	63.4	3.59	0.0005	0	A99
NUM31	-207.5	75.6	-2.74	0.0072	0	S52
NUM32	157.9	63.8	2.47	0.0151	0	A31

5.23 Cirebon

Parameter	Estimate	SE	T	p-value	Lag	Variable
AR1,1	0.7301	0.1069	6.83	<.0001	1	Y
AR1,2	0.4521	0.1260	3.59	0.0005	2	Y
AR1,3	-0.2914	0.1118	-2.61	0.0106	3	Y
AR2,1	0.6156	0.1060	5.81	<.0001	12	Y
NUM1	13.0	3.7	3.54	0.0006	0	t
NUM2	-315.6	117.7	-2.68	0.0086	0	H24t
NUM3	483.8	133.4	3.63	0.0005	0	H13t
NUM4	685.3	137.2	5.00	<.0001	0	H2t
NUM5	125.4	141.6	0.89	0.3780	0	H23t
NUM6	396.5	133.6	2.97	0.0038	0	H12t
NUM7	558.2	136.0	4.11	<.0001	0	H0t
NUM8	27.8	119.0	0.23	0.8156	0	H19t
NUM9	-127.1	134.6	-0.94	0.3474	0	H9t
NUM10	-187.1	122.6	-1.53	0.1301	0	H30t
NUM11	468.1	140.3	3.34	0.0012	0	H18t
NUM12	922.9	142.7	6.47	<.0001	0	H7t
NUM13	0.0	0.0	.	.	0	H27t
NUM14	961.6	117.7	8.17	<.0001	0	H24tm1
NUM15	235.6	130.6	1.80	0.0743	0	H13tm1
NUM16	37.9	121.6	0.31	0.7563	0	H2tm1
NUM17	490.2	188.4	2.60	0.0107	0	H23tm1
NUM18	166.7	133.0	1.25	0.2132	0	H12tm1
NUM19	2.8	118.1	0.02	0.9811	0	H0tm1
NUM20	527.0	132.0	3.99	0.0001	0	H19tm1
NUM21	-435.4	120.2	-3.62	0.0005	0	H9tm1
NUM22	967.5	139.1	6.96	<.0001	0	H30tm1
NUM23	2.3	143.4	0.02	0.9873	0	H18tm1
NUM24	-389.8	142.6	-2.73	0.0074	0	H7tm1
NUM25	0.0	0.0	.	.	0	H27tm1
NUM26	512.1	98.7	5.19	<.0001	0	A1
NUM27	-545.1	217.0	-2.51	0.0136	0	S48
NUM28	-1080.0	99.2	-10.88	<.0001	0	A97
NUM29	-603.0	96.6	-6.24	<.0001	0	A98
NUM30	460.6	118.3	3.89	0.0002	0	A121

5.24 Jawa Tengah

Parameter	Estimate	SE	T	p-value	Lag	Variable
AR1,1	0.2108	0.0816	2.58	0.0113	1	Y
AR1,2	0.5752	0.0835	6.88	<.0001	3	Y
AR2,1	0.6467	0.0860	7.52	<.0001	12	Y
NUM1	13.6	3.2	4.20	<.0001	0	t
NUM2	-179.3	255.5	-0.70	0.4846	0	H24t
NUM3	772.9	301.6	2.56	0.0119	0	H13t
NUM4	1399.2	315.3	4.44	<.0001	0	H2t
NUM5	40.3	254.5	0.16	0.8744	0	H23t
NUM6	408.2	300.5	1.36	0.1774	0	H12t
NUM7	1379.7	310.5	4.44	<.0001	0	H0t
NUM8	-85.8	253.9	-0.34	0.7360	0	H19t
NUM9	1271.9	318.0	4.00	0.0001	0	H9t

NUM10	-725.1	261.9	-2.77	0.0067	0	H30t
NUM11	942.0	305.8	3.08	0.0027	0	H18t
NUM12	3789.5	323.4	11.72	<.0001	0	H7t
NUM13	0.0	0.0	.	.	0	H27t
NUM14	1173.5	250.1	4.69	<.0001	0	H24tm1
NUM15	416.5	280.5	1.48	0.1408	0	H13tm1
NUM16	399.4	249.1	1.60	0.1119	0	H2tm1
NUM17	1080.2	315.6	3.42	0.0009	0	H23tm1
NUM18	1484.2	300.4	4.94	<.0001	0	H12tm1
NUM19	406.4	253.9	1.60	0.1127	0	H0tm1
NUM20	1398.1	298.2	4.69	<.0001	0	H19tm1
NUM21	-221.4	273.3	-0.81	0.4199	0	H9tm1
NUM22	2687.7	319.4	8.41	<.0001	0	H30tm1
NUM23	1244.9	327.6	3.80	0.0002	0	H18tm1
NUM24	112.7	330.5	0.34	0.7337	0	H7tm1
NUM25	0.0	0.0	.	.	0	H27tm1
NUM26	1678.2	221.1	7.59	<.0001	0	A95
NUM27	1281.1	254.9	5.03	<.0001	0	A121
NUM28	-1335.0	236.7	-5.64	<.0001	0	A97
NUM29	693.4	237.8	2.92	0.0044	0	A96

5.25 Yogyakarta

Parameter	Estimate	SE	T	p-value	Lag	Variable
MA1,1	-0.6169	0.1015	-6.08	<.0001	3	Y
AR1,1	0.6605	0.0803	8.22	<.0001	1	Y
AR2,1	0.8861	0.0660	13.42	<.0001	12	Y
NUM1	11.0	3.3	3.36	0.0011	0	t
NUM2	-110.2	104.8	-1.05	0.2956	0	H24t
NUM3	544.7	123.8	4.40	<.0001	0	H13t
NUM4	703.1	132.7	5.30	<.0001	0	H2t
NUM5	-109.5	113.1	-0.97	0.3354	0	H23t
NUM6	386.3	125.7	3.07	0.0027	0	H12t
NUM7	620.3	129.2	4.80	<.0001	0	H0t
NUM8	87.2	107.2	0.81	0.4180	0	H19t
NUM9	678.1	131.1	5.17	<.0001	0	H9t
NUM10	-243.6	110.4	-2.21	0.0297	0	H30t
NUM11	705.3	141.0	5.00	<.0001	0	H18t
NUM12	1813.2	164.1	11.05	<.0001	0	H7t
NUM13	0.0	0.0	.	.	0	H27t
NUM14	715.0	106.1	6.74	<.0001	0	H24tm1
NUM15	320.5	111.9	2.86	0.0051	0	H13tm1
NUM16	161.2	100.7	1.60	0.1125	0	H2tm1
NUM17	225.2	140.3	1.60	0.1117	0	H23tm1
NUM18	203.2	124.9	1.63	0.1071	0	H12tm1
NUM19	-1.2	104.9	-0.01	0.9912	0	H0tm1
NUM20	334.6	123.1	2.72	0.0078	0	H19tm1
NUM21	-245.3	113.4	-2.16	0.0329	0	H9tm1
NUM22	1262.6	150.3	8.40	<.0001	0	H30tm1
NUM23	21.6	172.1	0.13	0.9005	0	H18tm1
NUM24	228.3	181.5	1.26	0.2114	0	H7tm1
NUM25	0.0	0.0	.	.	0	H27tm1
NUM26	375.7	80.4	4.68	<.0001	0	A1
NUM27	-712.3	100.0	-7.12	<.0001	0	A97
NUM28	-434.5	107.6	-4.04	0.0001	0	S45
NUM29	-386.2	90.9	-4.25	<.0001	0	A98
NUM30	-272.5	93.6	-2.91	0.0044	0	A114
NUM31	256.3	84.7	3.03	0.0032	0	A31

5.26 Solo

Parameter	Estimate	SE	T	p-value	Lag	Variable
AR1,1	0.7505	0.0713	10.52	<.0001	1	Y
AR2,1	0.5474	0.0964	5.68	<.0001	12	Y
NUM1	15.2	2.6	5.87	<.0001	0	t
NUM2	-222.1	176.3	-1.26	0.2105	0	H24t
NUM3	530.5	197.7	2.68	0.0085	0	H13t
NUM4	851.7	199.2	4.27	<.0001	0	H2t

NUM5	206.2	233.9	0.88	0.3800	0	H23t
NUM6	524.8	197.0	2.66	0.0090	0	H12t
NUM7	1079.5	197.3	5.47	<.0001	0	H0t
NUM8	107.3	175.5	0.61	0.5422	0	H19t
NUM9	484.4	193.4	2.50	0.0139	0	H9t
NUM10	-250.0	176.2	-1.42	0.1592	0	H30t
NUM11	598.4	199.3	3.00	0.0034	0	H18t
NUM12	1683.1	205.5	8.19	<.0001	0	H7t
NUM13	0.0	0.0	.	.	0	H27t
NUM14	754.2	180.7	4.17	<.0001	0	H24tm1
NUM15	309.1	194.1	1.59	0.1145	0	H13tm1
NUM16	242.0	178.9	1.35	0.1792	0	H2tm1
NUM17	1056.7	212.7	4.97	<.0001	0	H23tm1
NUM18	667.5	197.0	3.39	0.0010	0	H12tm1
NUM19	117.0	175.9	0.67	0.5075	0	H0tm1
NUM20	685.9	192.5	3.56	0.0006	0	H19tm1
NUM21	-90.7	175.2	-0.52	0.6059	0	H9tm1
NUM22	1245.7	199.7	6.24	<.0001	0	H30tm1
NUM23	658.2	205.8	3.20	0.0019	0	H18tm1
NUM24	-81.6	207.5	-0.39	0.6948	0	H7tm1
NUM25	0.0	0.0	.	.	0	H27tm1
NUM26	-750.3	218.6	-3.43	0.0009	0	S46
NUM27	464.8	139.2	3.34	0.0012	0	A1
NUM28	-581.4	135.1	-4.30	<.0001	0	A97
NUM29	904.9	157.9	5.73	<.0001	0	A121
NUM30	1096.4	135.5	8.09	<.0001	0	A119

5.27 Purwokerto

Parameter	Estimate	SE	T	p-value	Lag	Variable
MA1,1	-0.1727	0.1203	-1.44	0.1545	3	Y
AR1,1	0.2821	0.1018	2.77	0.0067	1	Y
AR1,2	0.5892	0.0931	6.33	<.0001	2	Y
AR2,1	0.6167	0.0942	6.55	<.0001	12	Y
NUM1	6.8	2.1	3.25	0.0016	0	t
NUM2	-139.3	81.6	-1.71	0.0909	0	H24t
NUM3	486.1	94.1	5.17	<.0001	0	H13t
NUM4	778.2	97.2	8.01	<.0001	0	H2t
NUM5	156.5	93.1	1.68	0.0960	0	H23t
NUM6	589.5	92.7	6.36	<.0001	0	H12t
NUM7	-101.5	95.0	-1.07	0.2883	0	H0t
NUM8	21.4	81.1	0.26	0.7922	0	H19t
NUM9	977.7	99.6	9.82	<.0001	0	H9t
NUM10	-117.2	82.0	-1.43	0.1563	0	H30t
NUM11	597.4	94.7	6.31	<.0001	0	H18t
NUM12	1756.9	104.8	16.76	<.0001	0	H7t
NUM13	0.0	0.0	.	.	0	H27t
NUM14	618.8	78.8	7.85	<.0001	0	H24tm1
NUM15	295.3	88.9	3.32	0.0013	0	H13tm1
NUM16	126.9	82.8	1.53	0.1288	0	H2tm1
NUM17	278.2	109.9	2.53	0.0130	0	H23tm1
NUM18	-122.7	93.0	-1.32	0.1900	0	H12tm1
NUM19	44.9	81.0	0.55	0.5811	0	H0tm1
NUM20	-29.5	92.4	-0.32	0.7500	0	H19tm1
NUM21	139.5	88.5	1.58	0.1181	0	H9tm1
NUM22	1436.6	98.0	14.67	<.0001	0	H30tm1
NUM23	678.1	100.1	6.78	<.0001	0	H18tm1
NUM24	219.1	100.1	2.19	0.0310	0	H7tm1
NUM25	0.0	0.0	.	.	0	H27tm1
NUM26	-353.5	101.4	-3.49	0.0007	0	S48
NUM27	276.6	69.3	3.99	0.0001	0	A1
NUM28	452.6	89.5	5.05	<.0001	0	A130
NUM29	405.8	99.0	4.10	<.0001	0	A121
NUM30	296.3	84.2	3.52	0.0007	0	A109
NUM31	424.4	76.1	5.58	<.0001	0	A95
NUM32	390.1	75.4	5.17	<.0001	0	A96

5.28 Tegal

Parameter	Estimate	SE	T	p-value	Lag	Variable
AR1,1	0.5817	0.1892	3.07	0.0057	1	Y
NUM1	2.1337	0.4163	5.12	<.0001	0	t
NUM2	0.0	0.0	.	.	0	H24t
NUM3	0.0	0.0	.	.	0	H13t
NUM4	0.0	0.0	.	.	0	H2t
NUM5	0.0	0.0	.	.	0	H23t
NUM6	0.0	0.0	.	.	0	H12t
NUM7	0.0	0.0	.	.	0	H0t
NUM8	0.0	0.0	.	.	0	H19t
NUM9	232.1	131.7	1.76	0.0927	0	H9t
NUM10	-131.3	128.5	-1.02	0.3183	0	H30t
NUM11	359.5	128.5	2.80	0.0108	0	H18t
NUM12	777.2	129.7	5.99	<.0001	0	H7t
NUM13	0.0	0.0	.	.	0	H27t
NUM14	0.0	0.0	.	.	0	H24tm1
NUM15	0.0	0.0	.	.	0	H13tm1
NUM16	0.0	0.0	.	.	0	H2tm1
NUM17	0.0	0.0	.	.	0	H23tm1
NUM18	0.0	0.0	.	.	0	H12tm1
NUM19	0.0	0.0	.	.	0	H0tm1
NUM20	0.0	0.0	.	.	0	H19tm1
NUM21	-99.9	130.6	-0.77	0.4527	0	H9tm1
NUM22	679.8	128.4	5.29	<.0001	0	H30tm1
NUM23	458.4	128.5	3.57	0.0018	0	H18tm1
NUM24	256.9	129.3	1.99	0.0601	0	H7tm1
NUM25	0.0	0.0	.	.	0	H27tm1
NUM26	428.1	116.1	3.69	0.0014	0	A121

5.29 Jawa Timur

Parameter	Estimate	SE	T	p-value	Lag	Variable
AR1,1	0.7729	0.0672	11.50	<.0001	1	Y
AR2,1	0.7826	0.0746	10.50	<.0001	12	Y
NUM1	24.6	6.5	3.77	0.0003	0	t
NUM2	-687.9	330.1	-2.08	0.0397	0	H24t
NUM3	876.9	400.6	2.19	0.0309	0	H13t
NUM4	2037.6	419.5	4.86	<.0001	0	H2t
NUM5	219.3	347.9	0.63	0.5299	0	H23t
NUM6	1984.6	398.5	4.98	<.0001	0	H12t
NUM7	1947.0	411.5	4.73	<.0001	0	H0t
NUM8	-61.9	331.3	-0.19	0.8521	0	H19t
NUM9	1504.3	410.2	3.67	0.0004	0	H9t
NUM10	-340.3	340.5	-1.00	0.3200	0	H30t
NUM11	705.3	425.3	1.66	0.1005	0	H18t
NUM12	4288.3	467.5	9.17	<.0001	0	H7t
NUM13	0.0	0.0	.	.	0	H27t
NUM14	1338.7	334.2	4.01	0.0001	0	H24tm1
NUM15	685.3	370.4	1.85	0.0673	0	H13tm1
NUM16	625.4	331.4	1.89	0.0620	0	H2tm1
NUM17	970.9	489.4	1.98	0.0500	0	H23tm1
NUM18	626.6	398.9	1.57	0.1194	0	H12tm1
NUM19	140.0	330.5	0.42	0.6728	0	H0tm1
NUM20	2293.4	388.5	5.90	<.0001	0	H19tm1
NUM21	338.4	375.5	0.90	0.3697	0	H9tm1
NUM22	3048.8	450.9	6.76	<.0001	0	H30tm1
NUM23	1462.9	483.3	3.03	0.0031	0	H18tm1
NUM24	261.3	501.4	0.52	0.6034	0	H7tm1
NUM25	0.0	0.0	.	.	0	H27tm1
NUM26	-1330.8	408.2	-3.26	0.0015	0	S48
NUM27	736.3	241.1	3.05	0.0029	0	A1
NUM28	-2138.4	227.9	-9.38	<.0001	0	A97
NUM29	1371.8	299.4	4.58	<.0001	0	A121
NUM30	1198.6	273.8	4.38	<.0001	0	A95
NUM31	886.2	226.2	3.92	0.0002	0	A79

5.30 Malang

Parameter	Estimate	SE	T	p-value	Lag	Variable
MA1,1	-0.5929	0.0989	-6.00	<.0001	1	Y
AR1,1	0.5923	0.0958	6.18	<.0001	2	Y
AR2,1	0.8219	0.0945	8.69	<.0001	12	Y
NUM1	9.4	2.4	4.01	0.0001	0	t
NUM2	-174.3	123.7	-1.41	0.1620	0	H24t
NUM3	343.4	152.6	2.25	0.0266	0	H13t
NUM4	537.1	162.9	3.30	0.0014	0	H2t
NUM5	153.7	131.9	1.17	0.2467	0	H23t
NUM6	321.3	151.7	2.12	0.0367	0	H12t
NUM7	794.8	158.6	5.01	<.0001	0	H0t
NUM8	13.8	127.2	0.11	0.9138	0	H19t
NUM9	417.5	163.3	2.56	0.0121	0	H9t
NUM10	-123.4	129.4	-0.95	0.3423	0	H30t
NUM11	528.8	164.4	3.22	0.0017	0	H18t
NUM12	1364.3	183.2	7.45	<.0001	0	H7t
NUM13	0.0	0.0	.	.	0	H27t
NUM14	519.4	120.6	4.31	<.0001	0	H24tm1
NUM15	256.0	136.9	1.87	0.0644	0	H13tm1
NUM16	111.4	123.8	0.90	0.3704	0	H2tm1
NUM17	323.1	182.0	1.78	0.0788	0	H23tm1
NUM18	156.0	152.7	1.02	0.3092	0	H12tm1
NUM19	25.5	125.4	0.20	0.8391	0	H0tm1
NUM20	484.2	149.7	3.24	0.0016	0	H19tm1
NUM21	-262.6	135.2	-1.94	0.0550	0	H9tm1
NUM22	985.1	179.6	5.49	<.0001	0	H30tm1
NUM23	78.3	192.9	0.41	0.6857	0	H18tm1
NUM24	182.4	201.2	0.91	0.3669	0	H7tm1
NUM25	0.0	0.0	.	.	0	H27tm1
NUM26	-243.9	138.1	-1.77	0.0805	0	S48
NUM27	314.0	93.8	3.35	0.0011	0	A1
NUM28	410.0	104.7	3.92	0.0002	0	A95
NUM29	-885.2	94.7	-9.35	<.0001	0	A97

5.31 Kediri

Parameter	Estimate	SE	T	p-value	Lag	Variable
AR1,1	0.4432	0.0987	4.49	<.0001	1	Y
AR1,2	0.4277	0.0978	4.37	<.0001	2	Y
AR2,1	0.7399	0.0801	9.24	<.0001	12	Y
NUM1	6.3	3.0	2.05	0.0429	0	t
NUM2	-288.5	113.6	-2.54	0.0126	0	H24t
NUM3	558.6	137.1	4.07	<.0001	0	H13t
NUM4	819.3	146.4	5.60	<.0001	0	H2t
NUM5	107.0	124.7	0.86	0.3927	0	H23t
NUM6	226.5	136.1	1.66	0.0991	0	H12t
NUM7	847.4	141.5	5.99	<.0001	0	H0t
NUM8	-73.5	116.3	-0.63	0.5290	0	H19t
NUM9	446.1	139.3	3.20	0.0018	0	H9t
NUM10	113.7	115.7	0.98	0.3281	0	H30t
NUM11	662.6	142.0	4.67	<.0001	0	H18t
NUM12	1614.5	151.9	10.63	<.0001	0	H7t
NUM13	0.0	0.0	.	.	0	H27t
NUM14	930.5	108.9	8.54	<.0001	0	H24tm1
NUM15	415.7	124.7	3.33	0.0012	0	H13tm1
NUM16	185.5	113.9	1.63	0.1066	0	H2tm1
NUM17	396.9	164.2	2.42	0.0175	0	H23tm1
NUM18	56.0	137.1	0.41	0.6837	0	H12tm1
NUM19	-44.7	114.4	-0.39	0.6967	0	H0tm1
NUM20	692.5	135.3	5.12	<.0001	0	H19tm1
NUM21	-109.2	113.9	-0.96	0.3403	0	H9tm1
NUM22	1081.4	151.1	7.16	<.0001	0	H30tm1
NUM23	320.9	157.6	2.04	0.0444	0	H18tm1
NUM24	443.0	160.6	2.76	0.0069	0	H7tm1
NUM25	0.0	0.0	.	.	0	H27tm1
NUM26	462.2	91.3	5.06	<.0001	0	A1
NUM27	-189.0	134.9	-1.40	0.1642	0	S48

NUM28	-765.5	88.2	-8.68	<.0001	0	A97
NUM29	473.0	114.1	4.15	<.0001	0	A121

5.32 Jember

Parameter	Estimate	SE	T	p-value	Lag	Variable
AR1,1	0.4013	0.0856	4.69	<.0001	1	Y
AR1,2	0.4372	0.0849	5.15	<.0001	3	Y
AR2,1	0.8132	0.0714	11.39	<.0001	12	Y
NUM1	6.5	1.8	3.69	0.0004	0	t
NUM2	-10.5	71.3	-0.15	0.8827	0	H24t
NUM3	341.5	88.7	3.85	0.0002	0	H13t
NUM4	485.8	95.2	5.10	<.0001	0	H2t
NUM5	193.2	74.7	2.59	0.0111	0	H23t
NUM6	212.3	86.6	2.45	0.0160	0	H12t
NUM7	495.9	90.7	5.46	<.0001	0	H0t
NUM8	92.6	71.6	1.29	0.1987	0	H19t
NUM9	478.5	91.8	5.21	<.0001	0	H9t
NUM10	-94.3	73.7	-1.28	0.2041	0	H30t
NUM11	305.3	94.7	3.22	0.0017	0	H18t
NUM12	538.7	105.6	5.10	<.0001	0	H7t
NUM13	0.0	0.0	.	.	0	H27t
NUM14	479.4	69.2	6.93	<.0001	0	H24tm1
NUM15	175.3	79.1	2.22	0.0289	0	H13tm1
NUM16	106.2	70.6	1.50	0.1355	0	H2tm1
NUM17	260.9	102.8	2.54	0.0127	0	H23tm1
NUM18	56.7	88.2	0.64	0.5218	0	H12tm1
NUM19	54.5	70.5	0.77	0.4411	0	H0tm1
NUM20	239.0	85.9	2.78	0.0065	0	H19tm1
NUM21	58.2	74.1	0.79	0.4342	0	H9tm1
NUM22	734.5	103.7	7.09	<.0001	0	H30tm1
NUM23	43.7	111.4	0.39	0.6955	0	H18tm1
NUM24	29.7	116.3	0.26	0.7992	0	H7tm1
NUM25	0.0	0.0	.	.	0	H27tm1
NUM26	227.1	54.6	4.16	<.0001	0	A1
NUM27	-275.7	65.1	-4.24	<.0001	0	S48
NUM28	-440.4	58.1	-7.58	<.0001	0	A97
NUM29	336.4	71.3	4.72	<.0001	0	A121
NUM30	366.8	57.0	6.43	<.0001	0	A95

5.33 Bali

Parameter	Estimate	SE	T	p-value	Lag	Variable
MA1,1	-0.0215	0.1125	-0.19	0.8487	2	Y
AR1,1	0.3239	0.0831	3.90	0.0002	1	Y
AR1,2	0.5614	0.0799	7.03	<.0001	3	Y
AR2,1	0.2831	0.1188	2.38	0.0191	12	Y
NUM1	10.0	2.2	4.53	<.0001	0	t
NUM2	-182.4	137.8	-1.32	0.1887	0	H24t
NUM3	151.4	141.5	1.07	0.2873	0	H13t
NUM4	280.4	141.3	1.98	0.0499	0	H2t
NUM5	-1.9	149.0	-0.01	0.9898	0	H23t
NUM6	132.7	141.3	0.94	0.3497	0	H12t
NUM7	206.2	141.6	1.46	0.1484	0	H0t
NUM8	-2.8	136.1	-0.02	0.9836	0	H19t
NUM9	258.7	141.4	1.83	0.0704	0	H9t
NUM10	-128.2	137.4	-0.93	0.3530	0	H30t
NUM11	94.9	141.3	0.67	0.5032	0	H18t
NUM12	570.8	141.3	4.04	0.0001	0	H7t
NUM13	0.0	0.0	.	.	0	H27t
NUM14	317.8	138.4	2.30	0.0237	0	H24tm1
NUM15	-20.7	141.6	-0.15	0.8842	0	H13tm1
NUM16	6.8	137.6	0.05	0.9604	0	H2tm1
NUM17	-13.1	164.7	-0.08	0.9366	0	H23tm1
NUM18	-181.0	140.8	-1.29	0.2017	0	H12tm1
NUM19	-183.2	135.5	-1.35	0.1795	0	H0tm1
NUM20	-92.4	142.2	-0.65	0.5173	0	H19tm1
NUM21	31.1	136.6	0.23	0.8203	0	H9tm1

NUM22	1090.4	141.5	7.70	<.0001	0	H30tm1
NUM23	349.2	141.3	2.47	0.0151	0	H18tm1
NUM24	161.8	142.9	1.13	0.2602	0	H7tm1
NUM25	0.0	0.0	.	.	0	H27tm1
NUM26	416.1	128.9	3.23	0.0017	0	A1
NUM27	-509.9	143.7	-3.55	0.0006	0	S48
NUM28	706.1	136.8	5.16	<.0001	0	A121

5.34 Nusa Tenggara Barat

Parameter	Estimate	SE	T	p-value	Lag	Variable
AR1,1	0.4676	0.1011	4.62	<.0001	1	Y
AR1,2	0.3781	0.1002	3.77	0.0003	2	Y
AR2,1	0.8879	0.0790	11.25	<.0001	12	Y
NUM1	4.7	1.9	2.49	0.0144	0	t
NUM2	-41.1	56.4	-0.73	0.4677	0	H24t
NUM3	82.2	70.2	1.17	0.2442	0	H13t
NUM4	107.7	76.0	1.42	0.1595	0	H2t
NUM5	4.3	60.0	0.07	0.9428	0	H23t
NUM6	-52.7	68.7	-0.77	0.4447	0	H12t
NUM7	165.1	72.4	2.28	0.0248	0	H0t
NUM8	-4.4	58.0	-0.08	0.9393	0	H19t
NUM9	-70.9	75.5	-0.94	0.3495	0	H9t
NUM10	20.8	58.4	0.36	0.7226	0	H30t
NUM11	243.9	77.6	3.14	0.0022	0	H18t
NUM12	411.1	88.1	4.67	<.0001	0	H7t
NUM13	0.0	0.0	.	.	0	H27t
NUM14	185.5	52.5	3.53	0.0006	0	H24tm1
NUM15	89.7	60.7	1.48	0.1427	0	H13tm1
NUM16	68.0	54.9	1.24	0.2180	0	H2tm1
NUM17	38.0	84.7	0.45	0.6544	0	H23tm1
NUM18	71.7	70.2	1.02	0.3094	0	H12tm1
NUM19	-29.2	56.3	-0.52	0.6046	0	H0tm1
NUM20	81.0	68.4	1.18	0.2396	0	H19tm1
NUM21	-101.9	55.9	-1.82	0.0714	0	H9tm1
NUM22	137.6	87.4	1.57	0.1188	0	H30tm1
NUM23	-93.2	95.9	-0.97	0.3338	0	H18tm1
NUM24	-80.9	101.8	-0.80	0.4283	0	H7tm1
NUM25	0.0	0.0	.	.	0	H27tm1
NUM26	-263.8	64.9	-4.07	<.0001	0	S48
NUM27	143.0	42.7	3.35	0.0011	0	A1
NUM28	213.5	40.7	5.24	<.0001	0	A29
NUM29	-322.0	42.4	-7.60	<.0001	0	A97
NUM30	-268.6	41.9	-6.41	<.0001	0	A98

5.35 Nusa Tenggara Timur

Parameter	Estimate	SE	T	p-value	Lag	Variable
AR1,1	0.3879	0.0962	4.03	0.0001	1	Y
AR1,2	0.4647	0.0989	4.70	<.0001	2	Y
AR2,1	0.9984	0.0577	17.32	<.0001	12	Y
NUM1	2.1	2.2	0.92	0.3587	0	t
NUM2	-38.2	38.3	-1.00	0.3212	0	H24t
NUM3	36.1	48.5	0.75	0.4580	0	H13t
NUM4	86.5	52.9	1.64	0.1051	0	H2t
NUM5	-26.2	41.2	-0.64	0.5256	0	H23t
NUM6	-15.5	47.4	-0.33	0.7451	0	H12t
NUM7	38.8	50.1	0.78	0.4400	0	H0t
NUM8	-23.6	42.3	-0.56	0.5786	0	H19t
NUM9	-28.4	57.9	-0.49	0.6257	0	H9t
NUM10	28.7	42.3	0.68	0.4987	0	H30t
NUM11	168.9	58.9	2.87	0.0051	0	H18t
NUM12	317.3	70.5	4.50	<.0001	0	H7t
NUM13	0.0	0.0	.	.	0	H27t
NUM14	107.8	35.3	3.05	0.0030	0	H24tm1
NUM15	115.5	41.3	2.80	0.0062	0	H13tm1
NUM16	94.8	37.6	2.52	0.0134	0	H2tm1
NUM17	50.0	58.6	0.85	0.3951	0	H23tm1

NUM18	50.6	48.9	1.03	0.3036	0	H12tm1
NUM19	20.3	39.2	0.52	0.6062	0	H0tm1
NUM20	-40.3	47.4	-0.85	0.3970	0	H19tm1
NUM21	-72.8	38.8	-1.88	0.0635	0	H9tm1
NUM22	107.6	70.4	1.53	0.1296	0	H30tm1
NUM23	7.6	80.9	0.09	0.9254	0	H18tm1
NUM24	22.6	90.1	0.25	0.8024	0	H7tm1
NUM25	0.0	0.0	.	.	0	H27tm1
NUM26	128.7	29.2	4.41	<.0001	0	A1
NUM27	-106.0	43.5	-2.44	0.0166	0	S48
NUM28	-403.0	28.2	-14.28	<.0001	0	A97
NUM29	-292.8	32.5	-9.02	<.0001	0	A98
NUM30	209.3	43.1	4.86	<.0001	0	A121
NUM31	-136.3	32.2	-4.24	<.0001	0	A86

5.36 Kalimantan Selatan

Parameter	Estimate	SE	T	p-value	Lag	Variable
AR1,1	0.2782	0.0845	3.29	0.0014	1	Y
AR1,2	0.5420	0.0826	6.56	<.0001	3	Y
AR2,1	0.5583	0.0957	5.84	<.0001	12	Y
NUM1	7.5	1.4	5.32	<.0001	0	t
NUM2	-63.9	94.4	-0.68	0.5000	0	H24t
NUM3	197.1	107.2	1.84	0.0690	0	H13t
NUM4	371.3	110.0	3.38	0.0010	0	H2t
NUM5	-132.3	101.2	-1.31	0.1944	0	H23t
NUM6	135.3	106.8	1.27	0.2083	0	H12t
NUM7	319.3	109.0	2.93	0.0042	0	H0t
NUM8	0.5	94.7	0.01	0.9958	0	H19t
NUM9	249.5	107.2	2.33	0.0220	0	H9t
NUM10	-264.1	97.0	-2.72	0.0077	0	H30t
NUM11	268.4	110.3	2.43	0.0167	0	H18t
NUM12	844.3	112.2	7.53	<.0001	0	H7t
NUM13	0.0	0.0	.	.	0	H27t
NUM14	314.4	94.0	3.34	0.0012	0	H24tm1
NUM15	106.1	104.0	1.02	0.3102	0	H13tm1
NUM16	73.2	95.7	0.77	0.4460	0	H2tm1
NUM17	186.6	121.1	1.54	0.1265	0	H23tm1
NUM18	26.5	106.6	0.25	0.8045	0	H12tm1
NUM19	139.7	93.6	1.49	0.1389	0	H0tm1
NUM20	366.9	106.6	3.44	0.0008	0	H19tm1
NUM21	171.0	96.8	1.77	0.0804	0	H9tm1
NUM22	836.9	110.2	7.59	<.0001	0	H30tm1
NUM23	429.6	111.9	3.84	0.0002	0	H18tm1
NUM24	88.5	112.3	0.79	0.4326	0	H7tm1
NUM25	0.0	0.0	.	.	0	H27tm1
NUM26	-365.9	87.2	-4.20	<.0001	0	S48
NUM27	382.5	83.6	4.57	<.0001	0	A95
NUM28	291.4	81.7	3.57	0.0006	0	A115
NUM29	627.5	107.1	5.86	<.0001	0	A121
NUM30	632.2	95.2	6.64	<.0001	0	A109

5.37 Kalimantan Barat

Parameter	Estimate	SE	T	p-value	Lag	Variable
MA1,1	-0.4757	0.1059	-4.49	<.0001	2	Y
AR1,1	0.3992	0.1042	3.83	0.0002	1	Y
AR1,2	0.2051	0.1032	1.99	0.0496	3	Y
AR2,1	0.7611	0.0817	9.31	<.0001	12	Y
NUM1	4.2	1.2	3.59	0.0005	0	t
NUM2	-29.6	66.6	-0.44	0.6580	0	H24t
NUM3	199.8	82.0	2.44	0.0166	0	H13t
NUM4	306.4	88.2	3.47	0.0008	0	H2t
NUM5	0.3	75.1	0.00	0.9965	0	H23t
NUM6	-10.3	82.9	-0.12	0.9010	0	H12t
NUM7	341.0	86.2	3.96	0.0001	0	H0t
NUM8	10.5	70.3	0.15	0.8812	0	H19t
NUM9	236.7	85.8	2.76	0.0069	0	H9t

NUM10	-89.8	70.2	-1.28	0.2036	0	H30t
NUM11	238.5	85.7	2.78	0.0064	0	H18t
NUM12	868.4	93.1	9.33	<.0001	0	H7t
NUM13	0.0	0.0	.	.	0	H27t
NUM14	319.4	65.0	4.92	<.0001	0	H24tm1
NUM15	155.2	74.7	2.08	0.0402	0	H13tm1
NUM16	135.0	68.8	1.96	0.0525	0	H2tm1
NUM17	109.5	98.9	1.11	0.2706	0	H23tm1
NUM18	199.7	83.1	2.40	0.0181	0	H12tm1
NUM19	2.2	69.9	0.03	0.9748	0	H0tm1
NUM20	279.3	81.8	3.42	0.0009	0	H19tm1
NUM21	-122.6	69.4	-1.77	0.0801	0	H9tm1
NUM22	681.7	92.4	7.38	<.0001	0	H30tm1
NUM23	208.5	97.4	2.14	0.0348	0	H18tm1
NUM24	51.9	100.6	0.52	0.6072	0	H7tm1
NUM25	0.0	0.0	.	.	0	H27tm1
NUM26	-297.3	78.7	-3.78	0.0003	0	S48
NUM27	-374.6	53.8	-6.96	<.0001	0	A97
NUM28	358.1	70.8	5.06	<.0001	0	A121
NUM29	268.5	53.6	5.01	<.0001	0	A74

5.38 Kalimantan Timur

Parameter	Estimate	SE	T	p-value	Lag	Variable
AR1,1	0.4783	0.0864	5.54	<.0001	2	Y
AR1,2	0.3198	0.0853	3.75	0.0003	3	Y
AR2,1	0.8028	0.0735	10.92	<.0001	12	Y
NUM1	3.8	1.5	2.52	0.0133	0	t
NUM2	-49.6	76.8	-0.65	0.5197	0	H24t
NUM3	257.6	94.5	2.73	0.0075	0	H13t
NUM4	250.4	101.5	2.47	0.0153	0	H2t
NUM5	111.7	76.4	1.46	0.1470	0	H23t
NUM6	291.7	92.5	3.15	0.0021	0	H12t
NUM7	272.1	97.1	2.80	0.0061	0	H0t
NUM8	197.2	78.3	2.52	0.0134	0	H19t
NUM9	270.4	100.7	2.69	0.0085	0	H9t
NUM10	-50.9	79.3	-0.64	0.5224	0	H30t
NUM11	557.9	98.2	5.68	<.0001	0	H18t
NUM12	719.7	108.7	6.62	<.0001	0	H7t
NUM13	0.0	0.0	.	.	0	H27t
NUM14	388.0	71.5	5.43	<.0001	0	H24tm1
NUM15	162.2	82.1	1.98	0.0510	0	H13tm1
NUM16	170.6	73.4	2.32	0.0222	0	H2tm1
NUM17	60.9	101.4	0.60	0.5494	0	H23tm1
NUM18	-71.3	94.5	-0.75	0.4526	0	H12tm1
NUM19	-125.0	77.5	-1.61	0.1098	0	H0tm1
NUM20	236.2	92.5	2.55	0.0121	0	H19tm1
NUM21	14.4	78.5	0.18	0.8546	0	H9tm1
NUM22	590.8	108.3	5.45	<.0001	0	H30tm1
NUM23	85.3	114.8	0.74	0.4596	0	H18tm1
NUM24	62.9	118.7	0.53	0.5972	0	H7tm1
NUM25	0.0	0.0	.	.	0	H27tm1
NUM26	-235.6	47.5	-4.96	<.0001	0	S41
NUM27	215.2	60.4	3.57	0.0006	0	A1
NUM28	196.6	68.2	2.88	0.0048	0	A95
NUM29	-338.5	64.5	-5.25	<.0001	0	A97

5.39 Kalimantan Tengah

Parameter	Estimate	SE	T	p-value	Lag	Variable
NUM1	0.7	0.1	6.01	0.0001	0	t
NUM2	0.0	0.0	.	.	0	H24t
NUM3	0.0	0.0	.	.	0	H13t
NUM4	0.0	0.0	.	.	0	H2t
NUM5	0.0	0.0	.	.	0	H23t
NUM6	0.0	0.0	.	.	0	H12t
NUM7	0.0	0.0	.	.	0	H0t
NUM8	0.0	0.0	.	.	0	H19t

NUM9	0.0	0.0	.	.	0	H9t
NUM10	-51.5	75.4	-0.68	0.5104	0	H30t
NUM11	51.9	75.7	0.69	0.5082	0	H18t
NUM12	313.7	76.0	4.13	0.0021	0	H7t
NUM13	0.0	0.0	.	.	0	H27t
NUM14	0.0	0.0	.	.	0	H24tm1
NUM15	0.0	0.0	.	.	0	H13tm1
NUM16	0.0	0.0	.	.	0	H2tm1
NUM17	0.0	0.0	.	.	0	H23tm1
NUM18	0.0	0.0	.	.	0	H12tm1
NUM19	0.0	0.0	.	.	0	H0tm1
NUM20	0.0	0.0	.	.	0	H19tm1
NUM21	0.0	0.0	.	.	0	H9tm1
NUM22	136.3	75.5	1.81	0.1010	0	H30tm1
NUM23	-12.2	75.7	-0.16	0.8755	0	H18tm1
NUM24	42.9	76.0	0.56	0.5852	0	H7tm1
NUM25	0.0	0.0	.	.	0	H27tm1
NUM26	217.9	75.8	2.87	0.0165	0	A121

5.40 Balikpapan

Parameter	Estimate	SE	T	p-value	Lag	Variable
AR1,1	0.8282	0.0576	14.39	<.0001	1	Y
AR2,1	0.8640	0.0690	12.53	<.0001	12	Y
NUM1	3.3	1.0	3.49	0.0007	0	t
NUM2	-53.6	31.5	-1.70	0.0919	0	H24t
NUM3	123.9	39.1	3.17	0.0020	0	H13t
NUM4	205.6	41.4	4.96	<.0001	0	H2t
NUM5	46.6	33.8	1.38	0.1716	0	H23t
NUM6	231.9	38.9	5.96	<.0001	0	H12t
NUM7	322.7	40.7	7.92	<.0001	0	H0t
NUM8	13.2	32.2	0.41	0.6834	0	H19t
NUM9	198.5	40.5	4.90	<.0001	0	H9t
NUM10	11.3	33.0	0.34	0.7339	0	H30t
NUM11	242.2	42.9	5.65	<.0001	0	H18t
NUM12	734.9	48.9	15.04	<.0001	0	H7t
NUM13	0.0	0.0	.	.	0	H27t
NUM14	209.0	31.7	6.59	<.0001	0	H24tm1
NUM15	73.9	35.4	2.08	0.0397	0	H13tm1
NUM16	46.5	31.7	1.47	0.1452	0	H2tm1
NUM17	130.8	49.4	2.65	0.0094	0	H23tm1
NUM18	10.5	38.9	0.27	0.7872	0	H12tm1
NUM19	-7.7	31.7	-0.24	0.8098	0	H0tm1
NUM20	242.7	38.0	6.39	<.0001	0	H19tm1
NUM21	-32.0	31.5	-1.02	0.3119	0	H9tm1
NUM22	543.8	47.4	11.47	<.0001	0	H30tm1
NUM23	174.6	51.9	3.36	0.0011	0	H18tm1
NUM24	32.8	55.1	0.60	0.5524	0	H7tm1
NUM25	0.0	0.0	.	.	0	H27tm1
NUM26	-193.7	43.4	-4.46	<.0001	0	S48
NUM27	122.2	22.6	5.42	<.0001	0	A1
NUM28	-231.6	24.1	-9.60	<.0001	0	A97
NUM29	-137.3	24.2	-5.67	<.0001	0	A98
NUM30	153.3	28.9	5.30	<.0001	0	A121
NUM31	132.2	21.0	6.29	<.0001	0	A62

5.41 Sulawesi Selatan

Parameter	Estimate	SE	T	p-value	Lag	Variable
AR1,1	0.4453	0.0958	4.65	<.0001	1	Y
AR1,2	0.3626	0.0963	3.77	0.0003	2	Y
AR2,1	0.9307	0.0634	14.68	<.0001	12	Y
NUM1	12.2	5.4	2.27	0.0254	0	t
NUM2	-20.9	160.9	-0.13	0.8967	0	H24t
NUM3	182.2	206.3	0.88	0.3793	0	H13t
NUM4	672.0	225.4	2.98	0.0036	0	H2t
NUM5	-147.2	174.3	-0.84	0.4004	0	H23t
NUM6	197.2	204.0	0.97	0.3360	0	H12t

NUM7	740.5	216.3	3.42	0.0009	0	H0t
NUM8	66.4	175.5	0.38	0.7058	0	H19t
NUM9	492.7	235.3	2.09	0.0388	0	H9t
NUM10	5.9	176.4	0.03	0.9732	0	H30t
NUM11	912.0	237.0	3.85	0.0002	0	H18t
NUM12	1448.2	276.6	5.24	<.0001	0	H7t
NUM13	0.0	0.0	.	.	0	H27t
NUM14	697.0	152.0	4.58	<.0001	0	H24tm1
NUM15	326.2	177.7	1.84	0.0694	0	H13tm1
NUM16	367.5	161.2	2.28	0.0247	0	H2tm1
NUM17	166.5	247.3	0.67	0.5024	0	H23tm1
NUM18	129.8	208.3	0.62	0.5346	0	H12tm1
NUM19	66.1	166.7	0.40	0.6924	0	H0tm1
NUM20	708.7	203.6	3.48	0.0007	0	H19tm1
NUM21	-131.3	166.4	-0.79	0.4319	0	H9tm1
NUM22	1737.3	279.1	6.23	<.0001	0	H30tm1
NUM23	158.6	312.5	0.51	0.6128	0	H18tm1
NUM24	-249.8	339.2	-0.74	0.4632	0	H7tm1
NUM25	0.0	0.0	.	.	0	H27tm1
NUM26	-405.9	176.7	-2.30	0.0237	0	S48
NUM27	-1432.0	123.0	-11.64	<.0001	0	A97
NUM28	-529.5	122.6	-4.32	<.0001	0	A98

5.42 Sulawesi Tengah

Parameter	Estimate	SE	T	p-value	Lag	Variable
MA1,1	-0.3634	0.1021	-3.56	0.0006	5	Y
AR1,1	0.5184	0.0940	5.52	<.0001	1	Y
AR2,1	0.4632	0.1097	4.22	<.0001	12	Y
NUM1	2.3	0.4	5.89	<.0001	0	t
NUM2	-34.8	37.5	-0.93	0.3557	0	H24t
NUM3	56.9	40.7	1.40	0.1658	0	H13t
NUM4	109.0	41.3	2.64	0.0097	0	H2t
NUM5	28.1	38.6	0.73	0.4673	0	H23t
NUM6	118.4	40.9	2.90	0.0046	0	H12t
NUM7	231.9	41.0	5.65	<.0001	0	H0t
NUM8	18.0	37.5	0.48	0.6332	0	H19t
NUM9	114.0	40.3	2.83	0.0056	0	H9t
NUM10	-108.1	37.8	-2.86	0.0052	0	H30t
NUM11	137.9	43.6	3.17	0.0021	0	H18t
NUM12	451.8	45.3	9.97	<.0001	0	H7t
NUM13	0.0	0.0	.	.	0	H27t
NUM14	81.3	37.5	2.17	0.0325	0	H24tm1
NUM15	35.3	40.7	0.87	0.3882	0	H13tm1
NUM16	-19.3	39.2	-0.49	0.6244	0	H2tm1
NUM17	43.9	46.2	0.95	0.3451	0	H23tm1
NUM18	9.0	40.9	0.22	0.8255	0	H12tm1
NUM19	5.9	37.3	0.16	0.8745	0	H0tm1
NUM20	50.1	40.3	1.24	0.2167	0	H19tm1
NUM21	-47.5	37.2	-1.28	0.2048	0	H9tm1
NUM22	330.2	41.2	8.01	<.0001	0	H30tm1
NUM23	-8.4	42.3	-0.20	0.8425	0	H18tm1
NUM24	-18.9	45.5	-0.42	0.6780	0	H7tm1
NUM25	0.0	0.0	.	.	0	H27tm1
NUM26	-133.4	35.5	-3.76	0.0003	0	S48
NUM27	88.2	31.2	2.83	0.0057	0	A1
NUM28	293.3	39.3	7.45	<.0001	0	A121
NUM29	158.5	31.7	5.01	<.0001	0	A49

5.43 Sulawesi Utara

Parameter	Estimate	SE	T	p-value	Lag	Variable
AR1,1	0.8872	0.0490	18.09	<.0001	1	Y
AR2,1	0.8972	0.0683	13.14	<.0001	12	Y
NUM1	6.1	2.1	2.87	0.0050	0	t
NUM2	-51.3	42.6	-1.20	0.2315	0	H24t
NUM3	89.9	53.3	1.69	0.0950	0	H13t
NUM4	164.4	56.8	2.89	0.0047	0	H2t

NUM5	32.0	46.9	0.68	0.4970	0	H23t
NUM6	172.5	53.3	3.23	0.0017	0	H12t
NUM7	118.6	56.1	2.11	0.0373	0	H0t
NUM8	7.1	44.3	0.16	0.8731	0	H19t
NUM9	56.0	56.7	0.99	0.3252	0	H9t
NUM10	4.4	46.0	0.10	0.9235	0	H30t
NUM11	378.6	60.7	6.24	<.0001	0	H18t
NUM12	601.3	69.7	8.62	<.0001	0	H7t
NUM13	0.0	0.0	.	.	0	H27t
NUM14	200.1	42.9	4.66	<.0001	0	H24tm1
NUM15	155.0	48.2	3.22	0.0018	0	H13tm1
NUM16	68.6	43.2	1.59	0.1158	0	H2tm1
NUM17	118.2	70.0	1.69	0.0946	0	H23tm1
NUM18	24.1	53.1	0.45	0.6513	0	H12tm1
NUM19	3.5	43.2	0.08	0.9350	0	H0tm1
NUM20	15.5	52.2	0.30	0.7662	0	H19tm1
NUM21	-131.0	43.4	-3.02	0.0033	0	H9tm1
NUM22	434.2	67.5	6.43	<.0001	0	H30tm1
NUM23	36.4	74.9	0.49	0.6282	0	H18tm1
NUM24	-110.8	80.0	-1.38	0.1694	0	H7tm1
NUM25	0.0	0.0	.	.	0	H27tm1
NUM26	-230.8	65.7	-3.51	0.0007	0	S48
NUM27	155.8	30.4	5.13	<.0001	0	A1
NUM28	-496.6	43.5	-11.40	<.0001	0	A97
NUM29	291.5	32.6	8.94	<.0001	0	A61
NUM30	112.8	32.6	3.46	0.0008	0	A73
NUM31	600.5	57.0	10.53	<.0001	0	A109
NUM32	769.5	68.7	11.21	<.0001	0	A121
NUM33	-347.7	32.5	-10.69	<.0001	0	A98
NUM34	110.1	28.3	3.89	0.0002	0	A119

5.44 Sulawesi Tenggara

Parameter	Estimate	SE	T	p-value	Lag	Variable
AR1,1	0.3923	0.0908	4.32	<.0001	1	Y
AR1,2	0.4802	0.0917	5.24	<.0001	2	Y
AR2,1	0.7860	0.0771	10.19	<.0001	12	Y
NUM1	-34.3	34.4	-1.00	0.3216	0	H24t
NUM2	23.0	43.0	0.53	0.5947	0	H13t
NUM3	88.9	46.4	1.91	0.0583	0	H2t
NUM4	33.9	35.5	0.95	0.3419	0	H23t
NUM5	32.8	42.7	0.77	0.4432	0	H12t
NUM6	219.2	44.6	4.91	<.0001	0	H0t
NUM7	37.1	36.5	1.02	0.3110	0	H19t
NUM8	131.8	44.9	2.93	0.0041	0	H9t
NUM9	0.4	36.2	0.01	0.9914	0	H30t
NUM10	68.1	44.8	1.52	0.1312	0	H18t
NUM11	379.1	49.3	7.68	<.0001	0	H7t
NUM12	0.0	0.0	.	.	0	H27t
NUM13	124.7	32.9	3.79	0.0003	0	H24tm1
NUM14	65.5	38.2	1.71	0.0897	0	H13tm1
NUM15	135.6	34.9	3.88	0.0002	0	H2tm1
NUM16	55.4	46.7	1.19	0.2387	0	H23tm1
NUM17	-31.1	43.9	-0.71	0.4807	0	H12tm1
NUM18	-58.0	36.8	-1.58	0.1174	0	H0tm1
NUM19	120.2	42.6	2.82	0.0058	0	H19tm1
NUM20	-11.6	35.5	-0.33	0.7438	0	H9tm1
NUM21	208.1	49.7	4.19	<.0001	0	H30tm1
NUM22	123.2	52.3	2.35	0.0205	0	H18tm1
NUM23	46.6	53.9	0.87	0.3890	0	H7tm1
NUM24	0.0	0.0	.	.	0	H27tm1
NUM25	-110.1	28.7	-3.83	0.0002	0	S50
NUM26	196.3	28.1	6.99	<.0001	0	A85
NUM27	102.7	27.6	3.72	0.0003	0	A74

5.45 Maluku

Parameter	Estimate	SE	T	p-value	Lag	Variable
AR1,1	0.7754	0.0657	11.80	<.0001	1	Y
AR2,1	0.9587	0.0539	17.77	<.0001	12	Y
NUM1	-11.6	32.6	-0.36	0.7228	0	H24t
NUM2	50.7	41.4	1.22	0.2238	0	H13t
NUM3	55.7	44.4	1.25	0.2125	0	H2t
NUM4	27.5	34.9	0.79	0.4334	0	H23t
NUM5	68.1	41.7	1.63	0.1057	0	H12t
NUM6	97.7	44.3	2.21	0.0297	0	H0t
NUM7	0.4	35.0	0.01	0.9915	0	H19t
NUM8	72.0	46.4	1.55	0.1241	0	H9t
NUM9	-9.3	36.0	-0.26	0.7965	0	H30t
NUM10	-15.1	49.1	-0.31	0.7593	0	H18t
NUM11	225.9	58.3	3.88	0.0002	0	H7t
NUM12	0.0	0.0	.	.	0	H27t
NUM13	129.8	31.0	4.19	<.0001	0	H24tm1
NUM14	110.2	36.2	3.05	0.0029	0	H13tm1
NUM15	62.7	32.6	1.92	0.0572	0	H2tm1
NUM16	46.4	50.6	0.92	0.3618	0	H23tm1
NUM17	17.0	41.4	0.41	0.6812	0	H12tm1
NUM18	6.8	33.4	0.20	0.8382	0	H0tm1
NUM19	66.4	40.8	1.62	0.1073	0	H19tm1
NUM20	-47.8	33.3	-1.43	0.1550	0	H9tm1
NUM21	163.2	57.2	2.85	0.0052	0	H30tm1
NUM22	-11.8	65.0	-0.18	0.8561	0	H18tm1
NUM23	29.0	71.1	0.41	0.6842	0	H7tm1
NUM24	0.0	0.0	.	.	0	H27tm1
NUM25	-102.2	39.4	-2.59	0.0109	0	S48
NUM26	-232.4	22.0	-10.56	<.0001	0	A97
NUM27	192.1	32.5	5.91	<.0001	0	A121
NUM28	-77.1	21.9	-3.52	0.0006	0	A114

5.46 Maluku Utara

Parameter	Estimate	SE	T	p-value	Lag	Variable
MA1,1	-0.3043	0.1160	-2.62	0.0101	2	Y
AR1,1	0.6217	0.0885	7.03	<.0001	1	Y
AR2,1	0.9661	0.0884	10.93	<.0001	12	Y
NUM1	1.0	0.4	2.34	0.0215	0	t
NUM2	-21.1	13.7	-1.55	0.1255	0	H24t
NUM3	19.6	17.2	1.14	0.2557	0	H13t
NUM4	41.6	18.6	2.24	0.0271	0	H2t
NUM5	-29.1	14.9	-1.96	0.0530	0	H23t
NUM6	27.6	17.2	1.61	0.1110	0	H12t
NUM7	60.8	18.1	3.35	0.0011	0	H0t
NUM8	17.6	15.1	1.17	0.2446	0	H19t
NUM9	19.5	20.0	0.98	0.3312	0	H9t
NUM10	-23.6	15.3	-1.54	0.1264	0	H30t
NUM11	23.8	20.6	1.15	0.2510	0	H18t
NUM12	98.6	24.8	3.98	0.0001	0	H7t
NUM13	0.0	0.0	.	.	0	H27t
NUM14	33.1	12.9	2.56	0.0120	0	H24tm1
NUM15	12.2	14.9	0.82	0.4142	0	H13tm1
NUM16	-5.3	13.6	-0.39	0.6958	0	H2tm1
NUM17	11.7	21.0	0.56	0.5796	0	H23tm1
NUM18	-0.3	17.3	-0.02	0.9872	0	H12tm1
NUM19	-5.1	14.2	-0.36	0.7196	0	H0tm1
NUM20	30.1	17.0	1.77	0.0801	0	H19tm1
NUM21	-15.1	14.3	-1.06	0.2936	0	H9tm1
NUM22	114.8	24.2	4.75	<.0001	0	H30tm1
NUM23	18.6	27.3	0.68	0.4964	0	H18tm1
NUM24	11.9	29.9	0.40	0.6905	0	H7tm1
NUM25	0.0	0.0	.	.	0	H27tm1
NUM26	-74.0	15.8	-4.68	<.0001	0	S48
NUM27	35.6	10.2	3.48	0.0007	0	A1
NUM28	-88.7	10.2	-8.67	<.0001	0	A97
NUM29	-52.3	10.1	-5.16	<.0001	0	A98

5.47 Papua

Parameter	Estimate	SE	T	p-value	Lag	Variable
MA1,1	-0.5948	0.0939	-6.33	<.0001	4	Y
AR1,1	0.5255	0.0883	5.95	<.0001	1	Y
AR2,1	0.6944	0.0974	7.13	<.0001	12	Y
NUM1	3.2	1.0	3.30	0.0013	0	t
NUM2	-63.1	82.4	-0.77	0.4457	0	H24t
NUM3	59.7	108.1	0.55	0.5821	0	H13t
NUM4	72.9	113.9	0.64	0.5237	0	H2t
NUM5	125.9	83.0	1.52	0.1325	0	H23t
NUM6	-31.2	107.6	-0.29	0.7727	0	H12t
NUM7	84.5	112.8	0.75	0.4559	0	H0t
NUM8	-119.9	96.8	-1.24	0.2183	0	H19t
NUM9	28.4	120.5	0.24	0.8144	0	H9t
NUM10	-53.2	84.0	-0.63	0.5281	0	H30t
NUM11	233.6	112.8	2.07	0.0409	0	H18t
NUM12	522.9	127.0	4.12	<.0001	0	H7t
NUM13	0.0	0.0	.	.	0	H27t
NUM14	220.7	81.0	2.72	0.0076	0	H24tm1
NUM15	145.7	97.6	1.49	0.1387	0	H13tm1
NUM16	153.2	80.4	1.91	0.0595	0	H2tm1
NUM17	287.8	114.0	2.53	0.0131	0	H23tm1
NUM18	-13.2	108.4	-0.12	0.9034	0	H12tm1
NUM19	-67.7	82.8	-0.82	0.4159	0	H0tm1
NUM20	-65.0	106.2	-0.61	0.5416	0	H19tm1
NUM21	259.5	86.5	3.00	0.0034	0	H9tm1
NUM22	136.1	122.0	1.12	0.2671	0	H30tm1
NUM23	-27.0	139.9	-0.19	0.8476	0	H18tm1
NUM24	-21.4	142.5	-0.15	0.8807	0	H7tm1
NUM25	0.0	0.0	.	.	0	H27tm1
NUM26	558.4	104.3	5.35	<.0001	0	A121
NUM27	-405.0	78.4	-5.17	<.0001	0	A97
NUM28	179.4	69.9	2.57	0.0117	0	A73

Appendix 6. Parameter Estimates of the First Level ARIMAX Model for Currency Outflow

6.1 Indonesia

Parameter	Estimate	SE	T	p-value	Lag	Variable
AR1,1	0.2872	0.0947	3.03	0.0031	1	Y
AR1,2	0.4989	0.0883	5.65	<0.0001	3	Y
AR2,1	0.9469	0.0613	15.45	<0.0001	12	Y
NUM1	366.9	167.1	2.20	0.0304	0	t
NUM2	6992.4	5352.5	1.31	0.1944	0	H24tp1
NUM3	12602.1	6885.5	1.83	0.0701	0	H13tp1
NUM4	29001.9	7511.8	3.86	0.0002	0	H2tp1
NUM5	4361.5	5345.4	0.82	0.4164	0	H23tp1
NUM6	3840.4	6753.8	0.57	0.5709	0	H12tp1
NUM7	38307.1	7173.0	5.34	<0.0001	0	H0tp1
NUM8	1812.0	5621.3	0.32	0.7479	0	H19tp1
NUM9	7734.1	7722.5	1.00	0.3190	0	H9tp1
NUM10	2719.8	5653.4	0.48	0.6315	0	H30tp1
NUM11	9894.0	7836.4	1.26	0.2096	0	H18tp1
NUM12	51083.5	9271.1	5.51	<0.0001	0	H7tp1
NUM13	0.0	0.0	.	.	0	H27tp1
NUM14	21609.3	5040.9	4.29	<0.0001	0	H24t
NUM15	15262.9	5836.5	2.62	0.0103	0	H13t
NUM16	-4910.4	5141.1	-0.96	0.3418	0	H2t
NUM17	23502.7	7619.0	3.08	0.0026	0	H23t
NUM18	23969.9	6858.8	3.49	0.0007	0	H12t
NUM19	-1782.5	5340.0	-0.33	0.7392	0	H0t
NUM20	38885.1	6753.4	5.76	<0.0001	0	H19t
NUM21	28377.8	5610.3	5.06	<0.0001	0	H9t
NUM22	57693.1	9219.0	6.26	<0.0001	0	H30t
NUM23	56592.1	10404.4	5.44	<0.0001	0	H18t
NUM24	11865.3	11345.3	1.05	0.2981	0	H7t
NUM25	0.0	0.0	.	.	0	H27t
NUM26	-9661.4	3951.7	-2.44	0.0162	0	S49
NUM27	36081.9	4790.6	7.53	<0.0001	0	A96

6.2 Jakarta

Parameter	Estimate	SE	T	p-value	Lag	Variable
AR1,1	0.3430	0.0834	4.11	<.0001	1	Y
AR1,2	0.4582	0.0842	5.44	<.0001	3	Y
AR2,1	0.9067	0.0587	15.45	<.0001	12	Y
NUM1	101.6	50.6	2.01	0.0472	0	t
NUM2	2747.2	1793.9	1.53	0.1288	0	H24tp1
NUM3	4085.0	2291.1	1.78	0.0776	0	H13tp1
NUM4	9844.1	2488.4	3.96	0.0001	0	H2tp1
NUM5	264.6	1784.1	0.15	0.8824	0	H23tp1
NUM6	1308.1	2240.7	0.58	0.5606	0	H12tp1
NUM7	12505.5	2369.4	5.28	<.0001	0	H0tp1
NUM8	-394.7	1858.1	-0.21	0.8322	0	H19tp1
NUM9	2704.5	2481.9	1.09	0.2784	0	H9tp1
NUM10	-1059.4	1879.8	-0.56	0.5743	0	H30tp1
NUM11	1679.9	2563.8	0.66	0.5138	0	H18tp1
NUM12	15513.7	2959.7	5.24	<.0001	0	H7tp1
NUM13	0.0	0.0	.	.	0	H27tp1
NUM14	7860.9	1688.2	4.66	<.0001	0	H24t
NUM15	4415.1	1943.9	2.27	0.0252	0	H13t
NUM16	-999.9	1686.4	-0.59	0.5545	0	H2t
NUM17	8645.0	2477.5	3.49	0.0007	0	H23t
NUM18	7075.4	2286.0	3.10	0.0025	0	H12t
NUM19	-1051.6	1789.0	-0.59	0.5580	0	H0t
NUM20	10823.3	2293.3	4.72	<.0001	0	H19t
NUM21	4427.1	1783.8	2.48	0.0147	0	H9t
NUM22	14717.0	2920.0	5.04	<.0001	0	H30t
NUM23	14857.0	3247.5	4.57	<.0001	0	H18t
NUM24	2361.5	3478.6	0.68	0.4988	0	H7t

NUM25	0.0	0.0	.	.	0	H27t
NUM26	-2579.2	1210.6	-2.13	0.0355	0	S40
NUM27	-12020.2	1440.9	-8.34	<.0001	0	A84

6.3 Sumatera

Parameter	Estimate	SE	T	p-value	Lag	Variable
AR1,1	0.3547	0.0880	4.03	0.0001	1	Y
AR1,2	0.4855	0.0871	5.57	<.0001	3	Y
AR2,1	1.0000	0.0541	18.48	<.0001	12	Y
NUM1	86.5	50.5	1.71	0.0897	0	t
NUM2	1275.1	963.5	1.32	0.1887	0	H24tp1
NUM3	2321.7	1241.0	1.87	0.0643	0	H13tp1
NUM4	5615.5	1352.1	4.15	<.0001	0	H2tp1
NUM5	897.6	967.7	0.93	0.3559	0	H23tp1
NUM6	1335.7	1230.3	1.09	0.2802	0	H12tp1
NUM7	6270.1	1319.2	4.75	<.0001	0	H0tp1
NUM8	703.6	1036.8	0.68	0.4989	0	H19tp1
NUM9	4104.4	1493.9	2.75	0.0071	0	H9tp1
NUM10	582.8	1048.3	0.56	0.5795	0	H30tp1
NUM11	2432.5	1474.2	1.65	0.1020	0	H18tp1
NUM12	10248.1	1808.9	5.67	<.0001	0	H7tp1
NUM13	0.0	0.0	.	.	0	H27tp1
NUM14	4203.1	904.4	4.65	<.0001	0	H24t
NUM15	3186.9	1048.9	3.04	0.0030	0	H13t
NUM16	-1046.3	923.3	-1.13	0.2598	0	H2t
NUM17	5315.8	1371.4	3.88	0.0002	0	H23t
NUM18	5015.1	1238.0	4.05	0.0001	0	H12t
NUM19	-512.3	963.1	-0.53	0.5959	0	H0t
NUM20	7879.0	1231.7	6.40	<.0001	0	H19t
NUM21	6748.7	1007.6	6.70	<.0001	0	H9t
NUM22	11649.3	1803.1	6.46	<.0001	0	H30t
NUM23	12588.0	2083.9	6.04	<.0001	0	H18t
NUM24	2453.4	2332.6	1.05	0.2954	0	H7t
NUM25	0.0	0.0	.	.	0	H27t
NUM26	-1941.3	727.3	-2.67	0.0089	0	S49
NUM27	8779.2	796.9	11.02	<.0001	0	A95
NUM28	11541.3	799.8	14.43	<.0001	0	A96

6.4 Jawa

Parameter	Estimate	SE	T	p-value	Lag	Variable
AR1,1	0.2675	0.0920	2.91	0.0045	1	Y
AR1,2	0.4213	0.0915	4.61	<.0001	3	Y
AR2,1	0.8503	0.0708	12.01	<.0001	12	Y
NUM1	116.3	26.2	4.44	<.0001	0	t
NUM2	1220.6	1679.9	0.73	0.4691	0	H24tp1
NUM3	3886.0	2129.5	1.82	0.0709	0	H13tp1
NUM4	9423.4	2305.7	4.09	<.0001	0	H2tp1
NUM5	1459.6	1745.3	0.84	0.4049	0	H23tp1
NUM6	1905.3	2082.8	0.91	0.3625	0	H12tp1
NUM7	12399.6	2195.4	5.65	<.0001	0	H0tp1
NUM8	52.8	1708.0	0.03	0.9754	0	H19tp1
NUM9	3847.8	2229.3	1.73	0.0873	0	H9tp1
NUM10	2136.4	1717.1	1.24	0.2163	0	H30tp1
NUM11	3770.5	2295.5	1.64	0.1035	0	H18tp1
NUM12	16599.6	2581.0	6.43	<.0001	0	H7tp1
NUM13	0.0	0.0	.	.	0	H27tp1
NUM14	6985.5	1607.5	4.35	<.0001	0	H24t
NUM15	5781.0	1850.5	3.12	0.0023	0	H13t
NUM16	-1162.8	1657.8	-0.70	0.4846	0	H2t
NUM17	5132.8	2329.9	2.20	0.0298	0	H23t
NUM18	6803.8	2115.4	3.22	0.0017	0	H12t
NUM19	-231.5	1670.9	-0.14	0.8901	0	H0t
NUM20	9460.8	2073.2	4.56	<.0001	0	H19t
NUM21	6278.8	1662.5	3.78	0.0003	0	H9t
NUM22	21324.1	2548.9	8.37	<.0001	0	H30t
NUM23	19591.6	2774.1	7.06	<.0001	0	H18t

NUM24	5001.3	2914.4	1.72	0.0892	0	H7t
NUM25	0.0	0.0	.	.	0	H27t
NUM26	-5124.3	1228.1	-4.17	<.0001	0	S48

6.5 Balinusra

Parameter	Estimate	SE	T	p-value	Lag	Variable
AR1,1	0.3711	0.0906	4.10	<.0001	1	Y
AR1,2	0.3394	0.0900	3.77	0.0003	3	Y
AR2,1	0.8392	0.0744	11.28	<.0001	12	Y
NUM1	21.3	5.7	3.73	0.0003	0	t
NUM2	337.0	360.3	0.94	0.3517	0	H24tp1
NUM3	362.9	453.8	0.80	0.4257	0	H13tp1
NUM4	476.6	489.0	0.97	0.3319	0	H2tp1
NUM5	-134.4	359.7	-0.37	0.7095	0	H23tp1
NUM6	-223.8	448.4	-0.50	0.6188	0	H12tp1
NUM7	1335.5	470.9	2.84	0.0055	0	H0tp1
NUM8	117.3	366.8	0.32	0.7497	0	H19tp1
NUM9	-22.1	473.2	-0.05	0.9629	0	H9tp1
NUM10	85.2	369.8	0.23	0.8181	0	H30tp1
NUM11	89.9	486.3	0.18	0.8538	0	H18tp1
NUM12	1095.8	546.8	2.00	0.0477	0	H7tp1
NUM13	0.0	0.0	.	.	0	H27tp1
NUM14	301.2	343.1	0.88	0.3820	0	H24t
NUM15	231.9	394.2	0.59	0.5577	0	H13t
NUM16	-367.2	346.1	-1.06	0.2912	0	H2t
NUM17	498.2	492.6	1.01	0.3143	0	H23t
NUM18	742.9	452.7	1.64	0.1039	0	H12t
NUM19	10.0	359.1	0.03	0.9778	0	H0t
NUM20	1072.4	443.5	2.42	0.0174	0	H19t
NUM21	442.0	358.0	1.23	0.2198	0	H9t
NUM22	1992.2	539.2	3.69	0.0004	0	H30t
NUM23	2239.4	586.3	3.82	0.0002	0	H18t
NUM24	868.6	612.5	1.42	0.1592	0	H7t
NUM25	0.0	0.0	.	.	0	H27t
NUM26	-930.8	253.4	-3.67	0.0004	0	S49

6.6 Kalimantan

Parameter	Estimate	SE	T	p-value	Lag	Variable
AR1,1	0.2613	0.0956	2.73	0.0074	1	Y
AR1,2	0.3803	0.0952	3.99	0.0001	2	Y
AR2,1	1.0000	0.0438	22.85	<.0001	12	Y
NUM1	23.2	9.57	2.43	0.0171	0	t
NUM2	314.2	381.89	0.82	0.4126	0	H24tp1
NUM3	687.3	492.72	1.39	0.1661	0	H13tp1
NUM4	2049.5	542.08	3.78	0.0003	0	H2tp1
NUM5	97.4	390.50	0.25	0.8036	0	H23tp1
NUM6	468.9	485.22	0.97	0.3362	0	H12tp1
NUM7	3181.4	511.75	6.22	<.0001	0	H0tp1
NUM8	200.2	428.21	0.47	0.6412	0	H19tp1
NUM9	1780.7	590.72	3.01	0.0033	0	H9tp1
NUM10	767.9	431.25	1.78	0.0780	0	H30tp1
NUM11	1338.3	593.00	2.26	0.0262	0	H18tp1
NUM12	4003.0	717.55	5.58	<.0001	0	H7tp1
NUM13	0.0	0.00	.	.	0	H27tp1
NUM14	1465.2	357.94	4.09	<.0001	0	H24t
NUM15	1051.1	418.03	2.51	0.0135	0	H13t
NUM16	-549.8	376.44	-1.46	0.1473	0	H2t
NUM17	1512.7	542.22	2.79	0.0063	0	H23t
NUM18	1432.0	500.06	2.86	0.0051	0	H12t
NUM19	-402.1	398.88	-1.01	0.3159	0	H0t
NUM20	2740.5	484.40	5.66	<.0001	0	H19t
NUM21	1954.0	407.52	4.80	<.0001	0	H9t
NUM22	4565.4	718.02	6.36	<.0001	0	H30t
NUM23	4259.5	826.29	5.15	<.0001	0	H18t
NUM24	1075.5	923.13	1.17	0.2468	0	H7t
NUM25	0.0	0.00	.	.	0	H27t

NUM26	-621.2	267.53	-2.32	0.0223	0	S49
NUM27	3612.4	303.95	11.88	<.0001	0	A95
NUM28	4552.4	287.58	15.83	<.0001	0	A96
NUM29	1113.0	470.95	2.36	0.0200	0	A132

6.7 Sulampua

Parameter	Estimate	SE	T	p-value	Lag	Variable
MA1,1	-0.1159	0.1200	-0.97	0.3365	1	Y
AR1,1	0.3089	0.1036	2.98	0.0036	2	Y
AR1,2	0.1922	0.0937	2.05	0.0429	3	Y
AR1,3	0.1908	0.1123	1.70	0.0925	4	Y
AR1,4	-0.0432	0.1095	-0.39	0.6938	6	Y
AR2,1	1.0000	0.0475	21.07	<.0001	12	Y
NUM1	21.1	15.9	1.33	0.1874	0	t
NUM2	350.0	585.2	0.60	0.5511	0	H24tp1
NUM3	529.7	757.7	0.70	0.4861	0	H13tp1
NUM4	1477.6	829.9	1.78	0.0780	0	H2tp1
NUM5	327.4	586.6	0.56	0.5780	0	H23tp1
NUM6	-236.5	745.1	-0.32	0.7516	0	H12tp1
NUM7	2732.4	793.2	3.44	0.0008	0	H0tp1
NUM8	70.4	648.8	0.11	0.9139	0	H19tp1
NUM9	-176.0	927.6	-0.19	0.8499	0	H9tp1
NUM10	-65.3	646.9	-0.10	0.9198	0	H30tp1
NUM11	622.4	911.3	0.68	0.4963	0	H18tp1
NUM12	2975.5	1113.9	2.67	0.0088	0	H7tp1
NUM13	0.0	0.0	.	.	0	H27tp1
NUM14	1096.8	548.2	2.00	0.0481	0	H24t
NUM15	489.8	634.8	0.77	0.4422	0	H13t
NUM16	-894.8	555.9	-1.61	0.1107	0	H2t
NUM17	2100.9	830.6	2.53	0.0130	0	H23t
NUM18	1197.0	760.5	1.57	0.1187	0	H12t
NUM19	-769.5	595.1	-1.29	0.1990	0	H0t
NUM20	1265.9	743.3	1.70	0.0917	0	H19t
NUM21	777.1	592.5	1.31	0.1926	0	H9t
NUM22	3304.3	1121.3	2.95	0.0040	0	H30t
NUM23	2675.1	1288.8	2.08	0.0405	0	H18t
NUM24	1210.8	1446.1	0.84	0.4044	0	H7t
NUM25	0.0	0.0	.	.	0	H27t
NUM26	4164.6	524.2	7.94	<.0001	0	A96

6.8 Jakarta

Parameter	Estimate	SE	T	p-value	Lag	Variable
AR1,1	0.3430	0.0834	4.11	<.0001	1	Y
AR1,2	0.4582	0.0842	5.44	<.0001	3	Y
AR2,1	0.9067	0.0587	15.45	<.0001	12	Y
NUM1	101.6	50.6	2.01	0.0472	0	t
NUM2	2747.2	1793.9	1.53	0.1288	0	H24tp1
NUM3	4085.0	2291.1	1.78	0.0776	0	H13tp1
NUM4	9844.1	2488.4	3.96	0.0001	0	H2tp1
NUM5	264.6	1784.1	0.15	0.8824	0	H23tp1
NUM6	1308.1	2240.7	0.58	0.5606	0	H12tp1
NUM7	12505.5	2369.4	5.28	<.0001	0	H0tp1
NUM8	-394.7	1858.1	-0.21	0.8322	0	H19tp1
NUM9	2704.5	2481.9	1.09	0.2784	0	H9tp1
NUM10	-1059.4	1879.8	-0.56	0.5743	0	H30tp1
NUM11	1679.9	2563.8	0.66	0.5138	0	H18tp1
NUM12	15513.7	2959.7	5.24	<.0001	0	H7tp1
NUM13	0.0	0.0	.	.	0	H27tp1
NUM14	7860.9	1688.2	4.66	<.0001	0	H24t
NUM15	4415.1	1943.9	2.27	0.0252	0	H13t
NUM16	-999.9	1686.4	-0.59	0.5545	0	H2t
NUM17	8645.0	2477.5	3.49	0.0007	0	H23t
NUM18	7075.4	2286.0	3.10	0.0025	0	H12t
NUM19	-1051.6	1789.0	-0.59	0.5580	0	H0t
NUM20	10823.3	2293.3	4.72	<.0001	0	H19t
NUM21	4427.1	1783.8	2.48	0.0147	0	H9t

NUM22	14717.0	2920.0	5.04	<.0001	0	H30t
NUM23	14857.0	3247.5	4.57	<.0001	0	H18t
NUM24	2361.5	3478.6	0.68	0.4988	0	H7t
NUM25	0.0	0.0	.	.	0	H27t
NUM26	-2579.2	1210.6	-2.13	0.0355	0	S40
NUM27	-12020.2	1440.9	-8.34	<.0001	0	A84

6.9 Aceh

Parameter	Estimate	SE	T	p-value	Lag	Variable
AR1,1	0.3312	0.0997	3.32	0.0012	1	Y
AR1,2	0.4194	0.0983	4.27	<.0001	2	Y
AR2,1	0.4596	0.1028	4.47	<.0001	12	Y
NUM1	5.5	1.2	4.43	<.0001	0	t
NUM2	13.8	106.9	0.13	0.8977	0	H24tp1
NUM3	128.7	118.3	1.09	0.2793	0	H13tp1
NUM4	126.4	120.5	1.05	0.2965	0	H2tp1
NUM5	193.4	109.5	1.77	0.0803	0	H23tp1
NUM6	218.4	118.5	1.84	0.0682	0	H12tp1
NUM7	225.0	119.8	1.88	0.0632	0	H0tp1
NUM8	138.6	108.9	1.27	0.2062	0	H19tp1
NUM9	-3.9	118.0	-0.03	0.9737	0	H9tp1
NUM10	362.9	108.8	3.33	0.0012	0	H30tp1
NUM11	246.4	118.3	2.08	0.0397	0	H18tp1
NUM12	462.9	120.1	3.85	0.0002	0	H7tp1
NUM13	0.0	0.0	.	.	0	H27tp1
NUM14	64.4	106.8	0.60	0.5477	0	H24t
NUM15	110.4	116.1	0.95	0.3435	0	H13t
NUM16	-122.9	109.2	-1.13	0.2630	0	H2t
NUM17	15.6	119.9	0.13	0.8966	0	H23t
NUM18	51.7	118.0	0.44	0.6624	0	H12t
NUM19	-164.8	108.4	-1.52	0.1316	0	H0t
NUM20	125.4	118.0	1.06	0.2908	0	H19t
NUM21	89.6	108.4	0.83	0.4104	0	H9t
NUM22	278.1	119.9	2.32	0.0223	0	H30t
NUM23	51.6	120.4	0.43	0.6691	0	H18t
NUM24	26.1	120.6	0.22	0.8293	0	H7t
NUM25	0.0	0.0	.	.	0	H27t
NUM26	-242.5	92.3	-2.63	0.0099	0	S49

6.10 Lhokseumawe

Parameter	Estimate	SE	T	p-value	Lag	Variable
AR1,1	0.6460	0.0807	8.00	<.0001	1	Y
AR2,1	0.6942	0.0899	7.72	<.0001	12	Y
NUM1	2.0	0.6	3.14	0.0022	0	t
NUM2	19.5	75.7	0.26	0.7973	0	H24tp1
NUM3	62.3	90.6	0.69	0.4931	0	H13tp1
NUM4	101.2	93.9	1.08	0.2837	0	H2tp1
NUM5	103.2	77.0	1.34	0.1830	0	H23tp1
NUM6	218.4	90.9	2.40	0.0180	0	H12tp1
NUM7	327.1	93.4	3.50	0.0007	0	H0tp1
NUM8	-5.4	77.0	-0.07	0.9441	0	H19tp1
NUM9	-62.3	90.5	-0.69	0.4931	0	H9tp1
NUM10	247.3	77.9	3.17	0.0020	0	H30tp1
NUM11	81.0	94.1	0.86	0.3915	0	H18tp1
NUM12	473.8	100.6	4.71	<.0001	0	H7tp1
NUM13	0.0	0.0	.	.	0	H27tp1
NUM14	42.8	74.0	0.58	0.5643	0	H24t
NUM15	22.9	83.9	0.27	0.7853	0	H13t
NUM16	-44.2	74.9	-0.59	0.5571	0	H2t
NUM17	176.4	94.4	1.87	0.0644	0	H23t
NUM18	168.6	92.6	1.82	0.0715	0	H12t
NUM19	-94.7	81.5	-1.16	0.2483	0	H0t
NUM20	279.7	88.6	3.16	0.0021	0	H19t
NUM21	9.0	76.5	0.12	0.9068	0	H9t
NUM22	378.8	97.2	3.90	0.0002	0	H30t
NUM23	261.6	102.2	2.56	0.0119	0	H18t

NUM24	83.8	104.5	0.80	0.4241	0	H7t
NUM25	0.0	0.0	.	.	0	H27t
NUM26	314.6	67.1	4.69	<.0001	0	A83
NUM27	393.1	64.5	6.10	<.0001	0	A95
NUM28	207.8	55.8	3.72	0.0003	0	A60

6.11 Sumatera Utara

Parameter	Estimate	SE	T	p-value	Lag	Variable
AR1,1	0.2814	0.0804	3.50	0.0007	1	Y
AR1,2	0.3936	0.0843	4.67	<.0001	3	Y
AR1,3	0.2767	0.0828	3.34	0.0012	5	Y
AR1,4	-0.3106	0.0778	-3.99	0.0001	12	Y
AR2,1	0.9222	0.0597	15.45	<.0001	12	Y
NUM1	12.3	4.0	3.10	0.0025	0	t
NUM2	187.6	206.7	0.91	0.3662	0	H24tp1
NUM3	489.9	237.0	2.07	0.0413	0	H13tp1
NUM4	1184.4	256.5	4.62	<.0001	0	H2tp1
NUM5	188.0	225.4	0.83	0.4063	0	H23tp1
NUM6	1.5	232.8	0.01	0.9947	0	H12tp1
NUM7	845.5	245.9	3.44	0.0009	0	H0tp1
NUM8	-26.2	216.4	-0.12	0.9040	0	H19tp1
NUM9	488.7	259.5	1.88	0.0626	0	H9tp1
NUM10	-224.2	215.8	-1.04	0.3013	0	H30tp1
NUM11	705.0	260.3	2.71	0.0080	0	H18tp1
NUM12	1030.0	300.2	3.43	0.0009	0	H7tp1
NUM13	0.0	0.0	.	.	0	H27tp1
NUM14	870.1	197.0	4.42	<.0001	0	H24t
NUM15	720.0	208.2	3.46	0.0008	0	H13t
NUM16	-93.2	205.3	-0.45	0.6507	0	H2t
NUM17	1094.6	263.6	4.15	<.0001	0	H23t
NUM18	380.2	237.0	1.60	0.1117	0	H12t
NUM19	-157.8	207.3	-0.76	0.4483	0	H0t
NUM20	967.9	232.8	4.16	<.0001	0	H19t
NUM21	960.9	211.3	4.55	<.0001	0	H9t
NUM22	1601.5	297.9	5.38	<.0001	0	H30t
NUM23	1706.7	325.7	5.24	<.0001	0	H18t
NUM24	923.8	352.3	2.62	0.0101	0	H7t
NUM25	0.0	0.0	.	.	0	H27t
NUM26	-516.5	164.4	-3.14	0.0022	0	S48
NUM27	1877.1	190.9	9.83	<.0001	0	A96

6.12 Sibolga

Parameter	Estimate	SE	T	p-value	Lag	Variable
AR1,1	0.3767	0.1073	3.51	0.0007	1	Y
AR1,2	0.2989	0.1106	2.70	0.0081	2	Y
AR2,1	1.0000	0.0559	17.88	<.0001	12	Y
NUM1	3.2	1.6	1.99	0.0488	0	t
NUM2	-39.1	59.9	-0.65	0.5152	0	H24tp1
NUM3	29.6	77.4	0.38	0.7028	0	H13tp1
NUM4	133.4	84.8	1.57	0.1188	0	H2tp1
NUM5	40.5	61.5	0.66	0.5119	0	H23tp1
NUM6	58.6	77.4	0.76	0.4509	0	H12tp1
NUM7	245.7	81.3	3.02	0.0032	0	H0tp1
NUM8	120.0	69.6	1.72	0.0878	0	H19tp1
NUM9	91.6	96.0	0.95	0.3425	0	H9tp1
NUM10	80.8	67.8	1.19	0.2362	0	H30tp1
NUM11	-2.4	94.5	-0.03	0.9800	0	H18tp1
NUM12	247.0	114.5	2.16	0.0333	0	H7tp1
NUM13	0.0	0.0	.	.	0	H27tp1
NUM14	65.5	56.2	1.17	0.2467	0	H24t
NUM15	45.6	65.3	0.70	0.4868	0	H13t
NUM16	-53.5	57.7	-0.93	0.3565	0	H2t
NUM17	117.1	85.0	1.38	0.1711	0	H23t
NUM18	26.1	79.1	0.33	0.7420	0	H12t
NUM19	-92.3	62.9	-1.47	0.1452	0	H0t
NUM20	7.5	77.3	0.10	0.9233	0	H19t

NUM21	118.6	63.0	1.88	0.0626	0	H9t
NUM22	361.2	116.8	3.09	0.0026	0	H30t
NUM23	308.6	133.9	2.31	0.0232	0	H18t
NUM24	-39.1	150.1	-0.26	0.7948	0	H7t
NUM25	0.0	0.0	.	.	0	H27t
NUM26	406.1	47.5	8.54	<.0001	0	A95
NUM27	641.4	45.8	14.00	<.0001	0	A96

6.13 Pematang Siantar

Parameter	Estimate	SE	T	p-value	Lag	Variable
AR1,1	0.6704	0.1793	3.74	0.0012	1	Y
AR2,1	0.8358	0.1761	4.75	0.0001	12	Y
NUM1	0.0	0.0	.	.	0	H24tp1
NUM2	0.0	0.0	.	.	0	H13tp1
NUM3	0.0	0.0	.	.	0	H2tp1
NUM4	0.0	0.0	.	.	0	H23tp1
NUM5	0.0	0.0	.	.	0	H12tp1
NUM6	0.0	0.0	.	.	0	H0tp1
NUM7	0.0	0.0	.	.	0	H19tp1
NUM8	195.7	207.0	0.95	0.3552	0	H9tp1
NUM9	-461.3	228.3	-2.02	0.0563	0	H30tp1
NUM10	-89.7	294.4	-0.30	0.7637	0	H18tp1
NUM11	273.6	328.9	0.83	0.4148	0	H7tp1
NUM12	0.0	0.0	.	.	0	H27tp1
NUM13	0.0	0.0	.	.	0	H24t
NUM14	0.0	0.0	.	.	0	H13t
NUM15	0.0	0.0	.	.	0	H2t
NUM16	0.0	0.0	.	.	0	H23t
NUM17	0.0	0.0	.	.	0	H12t
NUM18	0.0	0.0	.	.	0	H0t
NUM19	0.0	0.0	.	.	0	H19t
NUM20	194.0	166.6	1.16	0.2574	0	H9t
NUM21	508.9	278.0	1.83	0.0814	0	H30t
NUM22	373.4	318.8	1.17	0.2546	0	H18t
NUM23	144.7	338.5	0.43	0.6734	0	H7t
NUM24	0.0	0.0	.	.	0	H27t
NUM25	455.4	190.7	2.39	0.0264	0	A125

6.14 Bengkulu

Parameter	Estimate	SE	T	p-value	Lag	Variable
AR1,1	0.3505	0.0941	3.73	0.0003	1	Y
AR1,2	0.3952	0.0929	4.25	<.0001	3	Y
AR2,1	0.9597	0.0590	16.28	<.0001	12	Y
NUM1	3.8	1.3	2.80	0.0061	0	t
NUM2	5.2	48.6	0.11	0.9153	0	H24tp1
NUM3	62.5	62.4	1.00	0.3190	0	H13tp1
NUM4	141.3	67.9	2.08	0.0401	0	H2tp1
NUM5	-5.8	48.4	-0.12	0.9043	0	H23tp1
NUM6	-22.5	61.6	-0.37	0.7155	0	H12tp1
NUM7	142.0	65.9	2.16	0.0334	0	H0tp1
NUM8	78.6	52.3	1.50	0.1364	0	H19tp1
NUM9	148.8	73.7	2.02	0.0463	0	H9tp1
NUM10	120.1	52.7	2.28	0.0248	0	H30tp1
NUM11	88.8	73.9	1.20	0.2321	0	H18tp1
NUM12	619.6	87.6	7.07	<.0001	0	H7tp1
NUM13	0.0	0.0	.	.	0	H27tp1
NUM14	150.1	45.6	3.29	0.0014	0	H24t
NUM15	108.1	52.8	2.05	0.0433	0	H13t
NUM16	-49.3	46.2	-1.07	0.2894	0	H2t
NUM17	99.8	68.8	1.45	0.1499	0	H23t
NUM18	64.3	62.5	1.03	0.3067	0	H12t
NUM19	-105.6	48.5	-2.18	0.0319	0	H0t
NUM20	167.6	61.4	2.73	0.0075	0	H19t
NUM21	143.4	51.4	2.79	0.0063	0	H9t
NUM22	482.6	89.5	5.39	<.0001	0	H30t
NUM23	327.8	102.6	3.19	0.0019	0	H18t

NUM24	104.0	112.9	0.92	0.3594	0	H7t
NUM25	0.0	0.0	.	.	0	H27t
NUM26	-149.0	34.1	-4.37	<.0001	0	S49
NUM27	429.7	39.5	10.87	<.0001	0	A95
NUM28	399.7	39.7	10.08	<.0001	0	A96
NUM29	152.9	38.6	3.97	0.0001	0	A90

6.15 Jambi

Parameter	Estimate	SE	T	p-value	Lag	Variable
AR1,1	0.4579	0.0958	4.78	<.0001	1	Y
AR1,2	0.4238	0.0978	4.33	<.0001	2	Y
AR2,1	0.8948	0.0631	14.18	<.0001	12	Y
NUM1	8.8	4.1	2.15	0.0339	0	t
NUM2	54.9	85.7	0.64	0.5236	0	H24tp1
NUM3	132.2	110.4	1.20	0.2338	0	H13tp1
NUM4	435.6	121.1	3.60	0.0005	0	H2tp1
NUM5	-49.9	90.0	-0.55	0.5809	0	H23tp1
NUM6	161.4	109.8	1.47	0.1450	0	H12tp1
NUM7	527.2	115.8	4.55	<.0001	0	H0tp1
NUM8	-18.1	93.0	-0.19	0.8458	0	H19tp1
NUM9	71.1	121.1	0.59	0.5587	0	H9tp1
NUM10	170.3	94.0	1.81	0.0730	0	H30tp1
NUM11	124.3	122.0	1.02	0.3109	0	H18tp1
NUM12	481.8	141.5	3.41	0.0009	0	H7tp1
NUM13	0.0	0.0	.	.	0	H27tp1
NUM14	225.8	81.8	2.76	0.0069	0	H24t
NUM15	193.6	97.4	1.99	0.0495	0	H13t
NUM16	-55.9	92.4	-0.60	0.5469	0	H2t
NUM17	298.3	124.0	2.41	0.0179	0	H23t
NUM18	284.1	111.9	2.54	0.0126	0	H12t
NUM19	83.7	90.1	0.93	0.3553	0	H0t
NUM20	311.2	109.5	2.84	0.0054	0	H19t
NUM21	291.0	93.0	3.13	0.0023	0	H9t
NUM22	784.8	140.7	5.58	<.0001	0	H30t
NUM23	764.3	154.2	4.96	<.0001	0	H18t
NUM24	104.3	164.5	0.63	0.5273	0	H7t
NUM25	0.0	0.0	.	.	0	H27t
NUM26	-229.5	82.2	-2.79	0.0063	0	S48
NUM27	1048.9	70.7	14.83	<.0001	0	A95
NUM28	884.1	66.2	13.36	<.0001	0	A96

6.16 Sumatera Barat

Parameter	Estimate	SE	T	p-value	Lag	Variable
AR1,1	0.2715	0.1046	2.60	0.0108	2	Y
AR2,1	0.7326	0.0844	8.68	<.0001	12	Y
NUM1	6.5	0.8	8.27	<.0001	0	t
NUM2	41.9	128.9	0.32	0.7460	0	H24tp1
NUM3	179.9	156.9	1.15	0.2544	0	H13tp1
NUM4	508.2	167.9	3.03	0.0031	0	H2tp1
NUM5	49.4	130.5	0.38	0.7059	0	H23tp1
NUM6	106.9	157.9	0.68	0.5000	0	H12tp1
NUM7	472.1	164.6	2.87	0.0050	0	H0tp1
NUM8	-70.3	133.4	-0.53	0.5995	0	H19tp1
NUM9	325.8	163.9	1.99	0.0496	0	H9tp1
NUM10	120.6	131.8	0.92	0.3623	0	H30tp1
NUM11	330.2	161.4	2.05	0.0434	0	H18tp1
NUM12	927.4	176.1	5.27	<.0001	0	H7tp1
NUM13	0.0	0.0	.	.	0	H27tp1
NUM14	414.0	124.7	3.32	0.0013	0	H24t
NUM15	257.4	141.8	1.82	0.0725	0	H13t
NUM16	-81.0	126.8	-0.64	0.5243	0	H2t
NUM17	382.3	168.5	2.27	0.0254	0	H23t
NUM18	277.4	158.0	1.76	0.0822	0	H12t
NUM19	-160.3	130.7	-1.23	0.2228	0	H0t
NUM20	584.9	157.2	3.72	0.0003	0	H19t
NUM21	599.0	133.0	4.51	<.0001	0	H9t

NUM22	1061.3	176.7	6.01	<.0001	0	H30t
NUM23	1140.2	185.1	6.16	<.0001	0	H18t
NUM24	306.9	189.1	1.62	0.1076	0	H7t
NUM25	0.0	0.0	.	.	0	H27t
NUM26	-307.9	59.6	-5.17	<.0001	0	S49
NUM27	1023.2	107.5	9.52	<.0001	0	A95
NUM28	1724.9	104.6	16.48	<.0001	0	A96

6.17 Riau

Parameter	Estimate	SE	T	p-value	Lag	Variable
AR1,1	0.5752	0.0965	5.96	<.0001	1	Y
AR1,2	0.1260	0.0936	1.35	0.1812	3	Y
AR2,1	0.9282	0.0577	16.08	<.0001	12	Y
NUM1	9.4	5.5	1.70	0.0919	0	t
NUM2	336.5	278.6	1.21	0.2299	0	H24tp1
NUM3	536.9	352.9	1.52	0.1312	0	H13tp1
NUM4	1584.6	379.6	4.17	<.0001	0	H2tp1
NUM5	142.2	278.7	0.51	0.6110	0	H23tp1
NUM6	416.9	351.0	1.19	0.2376	0	H12tp1
NUM7	1764.9	371.6	4.75	<.0001	0	H0tp1
NUM8	79.7	288.6	0.28	0.7829	0	H19tp1
NUM9	617.1	384.7	1.60	0.1118	0	H9tp1
NUM10	133.5	295.3	0.45	0.6523	0	H30tp1
NUM11	407.6	400.4	1.02	0.3111	0	H18tp1
NUM12	2111.9	473.7	4.46	<.0001	0	H7tp1
NUM13	0.0	0.0	.	.	0	H27tp1
NUM14	1012.6	262.3	3.86	0.0002	0	H24t
NUM15	762.0	302.6	2.52	0.0133	0	H13t
NUM16	44.9	263.8	0.17	0.8651	0	H2t
NUM17	1647.9	376.5	4.38	<.0001	0	H23t
NUM18	1506.9	353.3	4.27	<.0001	0	H12t
NUM19	159.2	278.5	0.57	0.5688	0	H0t
NUM20	1887.0	344.9	5.47	<.0001	0	H19t
NUM21	1425.0	278.3	5.12	<.0001	0	H9t
NUM22	2129.4	462.2	4.61	<.0001	0	H30t
NUM23	2365.9	519.1	4.56	<.0001	0	H18t
NUM24	262.1	563.9	0.46	0.6431	0	H7t
NUM25	0.0	0.0	.	.	0	H27t
NUM26	1104.1	209.5	5.27	<.0001	0	A96
NUM27	482.6	193.9	2.49	0.0145	0	A66

6.18 Kepulauan Riau

Parameter	Estimate	SE	T	p-value	Lag	Variable
AR1,1	0.3858	0.1050	3.67	0.0004	1	Y
AR1,2	0.2923	0.1075	2.72	0.0077	2	Y
AR2,1	0.9968	0.0670	14.88	<.0001	12	Y
NUM1	7.7	2.9	2.68	0.0086	0	t
NUM2	103.2	106.8	0.97	0.3364	0	H24tp1
NUM3	199.8	138.1	1.45	0.1509	0	H13tp1
NUM4	421.2	151.6	2.78	0.0065	0	H2tp1
NUM5	137.6	109.4	1.26	0.2112	0	H23tp1
NUM6	175.0	137.0	1.28	0.2044	0	H12tp1
NUM7	688.0	145.4	4.73	<.0001	0	H0tp1
NUM8	51.5	118.9	0.43	0.6660	0	H19tp1
NUM9	284.6	165.1	1.72	0.0879	0	H9tp1
NUM10	83.0	120.3	0.69	0.4921	0	H30tp1
NUM11	102.5	166.5	0.62	0.5394	0	H18tp1
NUM12	719.8	201.9	3.57	0.0006	0	H7tp1
NUM13	0.0	0.0	.	.	0	H27tp1
NUM14	405.6	100.0	4.05	<.0001	0	H24t
NUM15	326.7	116.2	2.81	0.0059	0	H13t
NUM16	-98.7	102.9	-0.96	0.3394	0	H2t
NUM17	528.8	151.4	3.49	0.0007	0	H23t
NUM18	491.0	139.7	3.52	0.0007	0	H12t
NUM19	-108.5	110.5	-0.98	0.3285	0	H0t
NUM20	752.0	136.0	5.53	<.0001	0	H19t

NUM21	555.7	111.9	4.97	<.0001	0	H9t
NUM22	841.9	201.5	4.18	<.0001	0	H30t
NUM23	647.0	232.1	2.79	0.0063	0	H18t
NUM24	-110.0	259.8	-0.42	0.6729	0	H7t
NUM25	0.0	0.0	.	.	0	H27t
NUM26	-189.7	75.1	-2.53	0.0131	0	S43
NUM27	475.9	84.2	5.65	<.0001	0	A95
NUM28	842.5	81.8	10.30	<.0001	0	A96

6.19 Sumatera Selatan

Parameter	Estimate	SE	T	p-value	Lag	Variable
AR1,1	0.4848	0.0895	5.42	<.0001	2	Y
AR2,1	0.6197	0.0894	6.93	<.0001	12	Y
NUM1	13.4	2.2	6.05	<.0001	0	t
NUM2	60.0	281.3	0.21	0.8316	0	H24tp1
NUM3	292.8	329.8	0.89	0.3768	0	H13tp1
NUM4	748.3	344.8	2.17	0.0323	0	H2tp1
NUM5	182.7	289.8	0.63	0.5300	0	H23tp1
NUM6	86.6	331.6	0.26	0.7946	0	H12tp1
NUM7	706.6	341.1	2.07	0.0408	0	H0tp1
NUM8	219.3	292.8	0.75	0.4555	0	H19tp1
NUM9	391.0	337.8	1.16	0.2498	0	H9tp1
NUM10	763.2	292.8	2.61	0.0105	0	H30tp1
NUM11	421.6	336.8	1.25	0.2135	0	H18tp1
NUM12	1280.3	351.8	3.64	0.0004	0	H7tp1
NUM13	0.0	0.0	.	.	0	H27tp1
NUM14	381.2	277.3	1.37	0.1723	0	H24t
NUM15	357.9	312.6	1.14	0.2549	0	H13t
NUM16	-281.3	288.2	-0.98	0.3313	0	H2t
NUM17	238.3	356.7	0.67	0.5056	0	H23t
NUM18	529.0	332.7	1.59	0.1150	0	H12t
NUM19	-151.6	289.6	-0.52	0.6017	0	H0t
NUM20	865.9	331.4	2.61	0.0103	0	H19t
NUM21	187.3	290.8	0.64	0.5210	0	H9t
NUM22	1763.0	352.7	5.00	<.0001	0	H30t
NUM23	2100.6	358.2	5.86	<.0001	0	H18t
NUM24	341.8	360.9	0.95	0.3458	0	H7t
NUM25	0.0	0.0	.	.	0	H27t
NUM26	-489.4	180.9	-2.70	0.0080	0	S48
NUM27	2011.1	239.0	8.42	<.0001	0	A96

6.20 Lampung

Parameter	Estimate	SE	T	p-value	Lag	Variable
AR1,1	0.5886	0.0829	7.10	<.0001	1	Y
AR2,1	0.6351	0.0874	7.27	<.0001	12	Y
NUM1	7.4	1.5	4.90	<.0001	0	t
NUM2	-13.9	167.5	-0.08	0.9343	0	H24tp1
NUM3	181.4	195.5	0.93	0.3556	0	H13tp1
NUM4	583.2	201.1	2.90	0.0046	0	H2tp1
NUM5	-16.1	169.8	-0.09	0.9248	0	H23tp1
NUM6	181.1	198.3	0.91	0.3633	0	H12tp1
NUM7	649.5	199.6	3.25	0.0015	0	H0tp1
NUM8	-72.6	167.8	-0.43	0.6664	0	H19tp1
NUM9	672.3	192.7	3.49	0.0007	0	H9tp1
NUM10	211.6	169.8	1.25	0.2155	0	H30tp1
NUM11	761.8	200.1	3.81	0.0002	0	H18tp1
NUM12	1309.0	211.2	6.20	<.0001	0	H7tp1
NUM13	0.0	0.0	.	.	0	H27tp1
NUM14	289.0	164.5	1.76	0.0820	0	H24t
NUM15	253.5	184.4	1.37	0.1723	0	H13t
NUM16	-142.6	165.9	-0.86	0.3920	0	H2t
NUM17	348.8	201.0	1.74	0.0857	0	H23t
NUM18	204.6	197.6	1.04	0.3030	0	H12t
NUM19	-101.8	168.7	-0.60	0.5477	0	H0t
NUM20	315.1	191.7	1.64	0.1033	0	H19t
NUM21	255.0	167.5	1.52	0.1310	0	H9t

NUM22	1011.6	204.8	4.94	<.0001	0	H30t
NUM23	1188.5	213.0	5.58	<.0001	0	H18t
NUM24	-23.1	216.4	-0.11	0.9153	0	H7t
NUM25	0.0	0.0	.	.	0	H27t
NUM26	-324.6	118.2	-2.75	0.0071	0	S49
NUM27	877.1	127.3	6.89	<.0001	0	A95

6.21 Jawa Barat

Parameter	Estimate	SE	T	p-value	Lag	Variable
AR1,1	0.2589	0.0954	2.71	0.0078	1	Y
AR1,2	0.3931	0.0946	4.15	<.0001	3	Y
AR2,1	0.8620	0.0663	13.00	<.0001	12	Y
NUM1	23.9	4.8	4.93	<.0001	0	t
NUM2	285.1	331.5	0.86	0.3918	0	H24tp1
NUM3	836.5	420.3	1.99	0.0492	0	H13tp1
NUM4	1691.2	457.5	3.70	0.0004	0	H2tp1
NUM5	220.7	343.0	0.64	0.5214	0	H23tp1
NUM6	-5.3	413.3	-0.01	0.9898	0	H12tp1
NUM7	1995.4	435.8	4.58	<.0001	0	H0tp1
NUM8	-75.9	338.3	-0.22	0.8230	0	H19tp1
NUM9	772.4	444.3	1.74	0.0851	0	H9tp1
NUM10	384.9	339.7	1.13	0.2598	0	H30tp1
NUM11	354.3	458.4	0.77	0.4413	0	H18tp1
NUM12	3187.6	515.8	6.18	<.0001	0	H7tp1
NUM13	0.0	0.0	.	.	0	H27tp1
NUM14	1224.4	316.2	3.87	0.0002	0	H24t
NUM15	1058.1	363.5	2.91	0.0044	0	H13t
NUM16	-240.7	324.5	-0.74	0.4600	0	H2t
NUM17	1006.5	462.0	2.18	0.0317	0	H23t
NUM18	1383.9	418.9	3.30	0.0013	0	H12t
NUM19	156.5	329.7	0.47	0.6361	0	H0t
NUM20	1872.0	410.9	4.56	<.0001	0	H19t
NUM21	1351.4	328.5	4.11	<.0001	0	H9t
NUM22	4543.1	510.3	8.90	<.0001	0	H30t
NUM23	3572.1	557.5	6.41	<.0001	0	H18t
NUM24	397.8	590.4	0.67	0.5020	0	H7t
NUM25	0.0	0.0	.	.	0	H27t
NUM26	-1256.3	230.6	-5.45	<.0001	0	S48

6.22 Tasikmalaya

Parameter	Estimate	SE	T	p-value	Lag	Variable
AR1,1	0.1679	0.0945	1.78	0.0786	2	Y
AR1,2	0.4063	0.0912	4.46	<.0001	3	Y
AR1,3	0.2778	0.0977	2.84	0.0054	4	Y
AR2,1	0.6512	0.0866	7.52	<.0001	12	Y
NUM1	4.0	1.0	4.23	<.0001	0	t
NUM2	26.8	51.5	0.52	0.6032	0	H24tp1
NUM3	102.0	62.7	1.63	0.1069	0	H13tp1
NUM4	260.2	65.0	4.00	0.0001	0	H2tp1
NUM5	102.6	55.9	1.83	0.0696	0	H23tp1
NUM6	-2.9	60.8	-0.05	0.9625	0	H12tp1
NUM7	271.4	62.7	4.33	<.0001	0	H0tp1
NUM8	-16.2	51.6	-0.31	0.7536	0	H19tp1
NUM9	33.2	62.5	0.53	0.5962	0	H9tp1
NUM10	121.6	51.5	2.36	0.0201	0	H30tp1
NUM11	63.5	61.5	1.03	0.3049	0	H18tp1
NUM12	365.3	65.1	5.62	<.0001	0	H7tp1
NUM13	0.0	0.0	.	.	0	H27tp1
NUM14	170.9	50.6	3.38	0.0010	0	H24t
NUM15	203.1	57.0	3.56	0.0006	0	H13t
NUM16	-85.1	52.1	-1.63	0.1058	0	H2t
NUM17	171.6	69.0	2.49	0.0145	0	H23t
NUM18	51.6	60.9	0.85	0.3993	0	H12t
NUM19	-3.5	51.4	-0.07	0.9462	0	H0t
NUM20	129.1	60.5	2.13	0.0353	0	H19t
NUM21	165.4	54.1	3.06	0.0029	0	H9t

NUM22	322.5	64.9	4.97	<.0001	0	H30t
NUM23	388.6	66.6	5.83	<.0001	0	H18t
NUM24	219.5	67.2	3.26	0.0015	0	H7t
NUM25	0.0	0.0	.	.	0	H27t
NUM26	-204.8	38.3	-5.34	<.0001	0	S48
NUM27	421.1	46.4	9.08	<.0001	0	A96

6.23 Cirebon

Parameter	Estimate	SE	T	p-value	Lag	Variable
AR1,1	0.3369	0.0980	3.44	0.0009	1	Y
AR1,2	0.3378	0.1013	3.33	0.0012	2	Y
AR2,1	0.6242	0.0906	6.89	<.0001	12	Y
NUM1	4.7	1.2	3.83	0.0002	0	t
NUM2	52.0	109.5	0.47	0.6360	0	H24tp1
NUM3	168.3	128.8	1.31	0.1944	0	H13tp1
NUM4	568.1	135.2	4.20	<.0001	0	H2tp1
NUM5	113.8	113.7	1.00	0.3194	0	H23tp1
NUM6	40.5	129.8	0.31	0.7558	0	H12tp1
NUM7	499.4	132.9	3.76	0.0003	0	H0tp1
NUM8	-81.1	112.6	-0.72	0.4730	0	H19tp1
NUM9	270.5	129.1	2.10	0.0385	0	H9tp1
NUM10	238.6	111.7	2.13	0.0351	0	H30tp1
NUM11	250.2	130.7	1.91	0.0583	0	H18tp1
NUM12	758.6	136.3	5.57	<.0001	0	H7tp1
NUM13	0.0	0.0	.	.	0	H27tp1
NUM14	355.0	108.1	3.28	0.0014	0	H24t
NUM15	312.9	122.7	2.55	0.0123	0	H13t
NUM16	-106.6	116.2	-0.92	0.3612	0	H2t
NUM17	307.3	138.9	2.21	0.0292	0	H23t
NUM18	385.8	128.8	3.00	0.0034	0	H12t
NUM19	-92.9	111.2	-0.84	0.4054	0	H0t
NUM20	269.0	128.1	2.10	0.0382	0	H19t
NUM21	295.8	111.0	2.67	0.0089	0	H9t
NUM22	825.9	135.6	6.09	<.0001	0	H30t
NUM23	871.2	139.3	6.26	<.0001	0	H18t
NUM24	339.3	139.4	2.43	0.0166	0	H7t
NUM25	0.0	0.0	.	.	0	H27t
NUM26	-201.1	95.7	-2.10	0.0381	0	S48

6.24 Jawa Tengah

Parameter	Estimate	SE	T	p-value	Lag	Variable
AR1,1	0.4693	0.0927	5.06	<.0001	2	Y
AR1,2	0.3017	0.0927	3.25	0.0015	3	Y
AR2,1	0.7938	0.0743	10.69	<.0001	12	Y
NUM1	12.0	3.9	3.10	0.0025	0	t
NUM2	-36.5	220.8	-0.17	0.8690	0	H24tp1
NUM3	506.7	275.4	1.84	0.0687	0	H13tp1
NUM4	1340.9	298.0	4.50	<.0001	0	H2tp1
NUM5	274.6	228.1	1.20	0.2315	0	H23tp1
NUM6	241.6	274.0	0.88	0.3800	0	H12tp1
NUM7	2289.8	287.3	7.97	<.0001	0	H0tp1
NUM8	13.3	232.9	0.06	0.9545	0	H19tp1
NUM9	53.1	288.9	0.18	0.8545	0	H9tp1
NUM10	607.5	232.4	2.61	0.0103	0	H30tp1
NUM11	661.1	288.6	2.29	0.0240	0	H18tp1
NUM12	2211.4	323.5	6.84	<.0001	0	H7tp1
NUM13	0.0	0.0	.	.	0	H27tp1
NUM14	889.3	211.5	4.21	<.0001	0	H24t
NUM15	633.1	244.4	2.59	0.0110	0	H13t
NUM16	-444.7	219.2	-2.03	0.0451	0	H2t
NUM17	816.5	299.0	2.73	0.0074	0	H23t
NUM18	841.3	281.4	2.99	0.0035	0	H12t
NUM19	-69.2	234.8	-0.29	0.7689	0	H0t
NUM20	1419.7	277.1	5.12	<.0001	0	H19t
NUM21	413.9	229.6	1.80	0.0743	0	H9t
NUM22	2764.1	319.1	8.66	<.0001	0	H30t

NUM23	1888.0	340.6	5.54	<.0001	0	H18t
NUM24	560.4	349.2	1.60	0.1116	0	H7t
NUM25	0.0	0.0	.	.	0	H27t
NUM26	-377.1	140.3	-2.69	0.0084	0	S41
NUM27	-708.5	182.6	-3.88	0.0002	0	A84

6.25 Yogyakarta

Parameter	Estimate	SE	T	p-value	Lag	Variable
AR1,1	0.3087	0.0897	3.44	0.0008	1	Y
AR1,2	0.3447	0.0919	3.75	0.0003	3	Y
AR2,1	0.6307	0.0865	7.29	<.0001	12	Y
NUM1	11.7	1.8	6.37	<.0001	0	t
NUM2	50.2	188.8	0.27	0.7907	0	H24tp1
NUM3	316.5	221.4	1.43	0.1558	0	H13tp1
NUM4	711.5	230.5	3.09	0.0026	0	H2tp1
NUM5	-122.7	188.3	-0.65	0.5162	0	H23tp1
NUM6	158.2	220.7	0.72	0.4750	0	H12tp1
NUM7	804.4	226.2	3.56	0.0006	0	H0tp1
NUM8	96.7	188.0	0.51	0.6082	0	H19tp1
NUM9	90.1	221.1	0.41	0.6846	0	H9tp1
NUM10	-52.7	188.8	-0.28	0.7807	0	H30tp1
NUM11	234.0	223.6	1.05	0.2979	0	H18tp1
NUM12	1289.2	235.7	5.47	<.0001	0	H7tp1
NUM13	0.0	0.0	.	.	0	H27tp1
NUM14	513.4	186.1	2.76	0.0069	0	H24t
NUM15	535.5	206.9	2.59	0.0110	0	H13t
NUM16	-6.6	185.6	-0.04	0.9718	0	H2t
NUM17	137.4	234.6	0.59	0.5593	0	H23t
NUM18	493.4	221.0	2.23	0.0277	0	H12t
NUM19	-29.1	187.6	-0.16	0.8770	0	H0t
NUM20	890.1	218.0	4.08	<.0001	0	H19t
NUM21	620.3	187.9	3.30	0.0013	0	H9t
NUM22	1699.8	232.7	7.30	<.0001	0	H30t
NUM23	1723.3	239.1	7.21	<.0001	0	H18t
NUM24	222.6	241.6	0.92	0.3590	0	H7t
NUM25	0.0	0.0	.	.	0	H27t
NUM26	-589.6	132.2	-4.46	<.0001	0	S49

6.26 Solo

Parameter	Estimate	SE	T	p-value	Lag	Variable
AR1,1	0.4533	0.0937	4.84	<.0001	2	Y
AR1,2	0.2852	0.0932	3.06	0.0028	3	Y
AR2,1	0.6378	0.0904	7.05	<.0001	12	Y
NUM1	6.3	1.4	4.60	<.0001	0	t
NUM2	-50.3	114.3	-0.44	0.6610	0	H24tp1
NUM3	207.7	134.3	1.55	0.1249	0	H13tp1
NUM4	516.5	141.4	3.65	0.0004	0	H2tp1
NUM5	330.6	118.9	2.78	0.0065	0	H23tp1
NUM6	162.5	134.7	1.21	0.2305	0	H12tp1
NUM7	729.0	139.0	5.25	<.0001	0	H0tp1
NUM8	1.8	117.0	0.02	0.9880	0	H19tp1
NUM9	268.4	136.1	1.97	0.0513	0	H9tp1
NUM10	132.4	118.8	1.11	0.2678	0	H30tp1
NUM11	508.8	138.6	3.67	0.0004	0	H18tp1
NUM12	1081.3	145.8	7.42	<.0001	0	H7tp1
NUM13	0.0	0.0	.	.	0	H27tp1
NUM14	383.9	112.4	3.41	0.0009	0	H24t
NUM15	454.6	127.6	3.56	0.0006	0	H13t
NUM16	-44.8	119.3	-0.38	0.7080	0	H2t
NUM17	-153.8	142.0	-1.08	0.2813	0	H23t
NUM18	568.5	135.1	4.21	<.0001	0	H12t
NUM19	-63.2	116.6	-0.54	0.5892	0	H0t
NUM20	593.4	134.3	4.42	<.0001	0	H19t
NUM21	764.9	119.0	6.43	<.0001	0	H9t
NUM22	1192.4	143.3	8.32	<.0001	0	H30t
NUM23	1138.8	148.4	7.67	<.0001	0	H18t

NUM24	301.6	147.5	2.04	0.0435	0	H7t
NUM25	0.0	0.0	.	.	0	H27t
NUM26	-262.3	85.8	-3.06	0.0029	0	S49
NUM27	644.4	98.1	6.57	<.0001	0	A96

6.27 Purwokerto

Parameter	Estimate	SE	T	p-value	Lag	Variable
AR1,1	0.2119	0.0953	2.23	0.0283	1	Y
AR1,2	0.5119	0.0955	5.36	<.0001	3	Y
AR2,1	0.7730	0.0844	9.16	<.0001	12	Y
NUM1	6.9	1.4	4.76	<.0001	0	t
NUM2	89.7	97.4	0.92	0.3591	0	H24tp1
NUM3	255.2	121.6	2.10	0.0383	0	H13tp1
NUM4	698.3	130.3	5.36	<.0001	0	H2tp1
NUM5	217.1	103.9	2.09	0.0391	0	H23tp1
NUM6	62.3	123.4	0.51	0.6146	0	H12tp1
NUM7	804.4	125.0	6.44	<.0001	0	H0tp1
NUM8	22.6	98.3	0.23	0.8186	0	H19tp1
NUM9	172.3	123.7	1.39	0.1669	0	H9tp1
NUM10	150.0	98.9	1.52	0.1325	0	H30tp1
NUM11	160.9	127.9	1.26	0.2114	0	H18tp1
NUM12	1145.5	139.0	8.24	<.0001	0	H7tp1
NUM13	0.0	0.0	.	.	0	H27tp1
NUM14	487.4	94.7	5.15	<.0001	0	H24t
NUM15	417.6	108.3	3.86	0.0002	0	H13t
NUM16	-49.2	97.4	-0.50	0.6150	0	H2t
NUM17	458.5	133.3	3.44	0.0008	0	H23t
NUM18	599.8	121.0	4.96	<.0001	0	H12t
NUM19	-72.8	97.6	-0.75	0.4576	0	H0t
NUM20	66.4	118.6	0.56	0.5770	0	H19t
NUM21	506.6	96.9	5.23	<.0001	0	H9t
NUM22	1206.2	137.0	8.80	<.0001	0	H30t
NUM23	1376.2	145.2	9.48	<.0001	0	H18t
NUM24	185.8	149.1	1.25	0.2155	0	H7t
NUM25	0.0	0.0	.	.	0	H27t
NUM26	-367.2	75.9	-4.83	<.0001	0	S48
NUM27	306.0	84.5	3.62	0.0005	0	A60
NUM28	229.6	81.0	2.83	0.0055	0	A120

6.28 Tegal

Parameter	Estimate	SE	T	p-value	Lag	Variable
AR1,1	0.5138	0.2101	2.45	0.0234	1	Y
AR2,1	1.0000	0.2217	4.51	0.0002	12	Y
NUM1	1.3	0.9	1.44	0.1643	0	t
NUM2	0.0	0.0	.	.	0	H24tp1
NUM3	0.0	0.0	.	.	0	H13tp1
NUM4	0.0	0.0	.	.	0	H2tp1
NUM5	0.0	0.0	.	.	0	H23tp1
NUM6	0.0	0.0	.	.	0	H12tp1
NUM7	0.0	0.0	.	.	0	H0tp1
NUM8	0.0	0.0	.	.	0	H19tp1
NUM9	138.4	145.1	0.95	0.3511	0	H9tp1
NUM10	276.8	152.7	1.81	0.0841	0	H30tp1
NUM11	261.6	219.2	1.19	0.2462	0	H18tp1
NUM12	1091.3	273.2	3.99	0.0007	0	H7tp1
NUM13	0.0	0.0	.	.	0	H27tp1
NUM14	0.0	0.0	.	.	0	H24t
NUM15	0.0	0.0	.	.	0	H13t
NUM16	0.0	0.0	.	.	0	H2t
NUM17	0.0	0.0	.	.	0	H23t
NUM18	0.0	0.0	.	.	0	H12t
NUM19	0.0	0.0	.	.	0	H0t
NUM20	0.0	0.0	.	.	0	H19t
NUM21	375.6	107.9	3.48	0.0022	0	H9t
NUM22	774.0	204.1	3.79	0.0011	0	H30t
NUM23	965.8	254.6	3.79	0.0011	0	H18t

NUM24	135.0	298.1	0.45	0.6554	0	H7t
NUM25	0.0	0.0	.	.	0	H27t

6.29 Jawa Timur

Parameter	Estimate	SE	T	p-value	Lag	Variable
AR1,1	0.2699	0.0970	2.78	0.0064	2	Y
AR1,2	0.4886	0.1003	4.87	<.0001	3	Y
AR1,3	0.2807	0.0935	3.00	0.0034	4	Y
AR1,4	-0.3279	0.1007	-3.26	0.0015	6	Y
AR2,1	0.9393	0.0557	16.87	<.0001	12	Y
NUM1	26.9	7.0	3.86	0.0002	0	t
NUM2	396.0	275.2	1.44	0.1533	0	H24tp1
NUM3	778.0	354.9	2.19	0.0307	0	H13tp1
NUM4	2049.6	389.4	5.26	<.0001	0	H2tp1
NUM5	378.7	299.1	1.27	0.2084	0	H23tp1
NUM6	535.8	348.6	1.54	0.1274	0	H12tp1
NUM7	2516.2	370.4	6.79	<.0001	0	H0tp1
NUM8	-804.9	300.0	-2.68	0.0085	0	H19tp1
NUM9	1190.0	399.6	2.98	0.0036	0	H9tp1
NUM10	133.5	297.7	0.45	0.6548	0	H30tp1
NUM11	1089.8	405.8	2.69	0.0085	0	H18tp1
NUM12	2508.0	498.1	5.04	<.0001	0	H7tp1
NUM13	0.0	0.0	.	.	0	H27tp1
NUM14	1485.2	261.1	5.69	<.0001	0	H24t
NUM15	938.8	307.2	3.06	0.0029	0	H13t
NUM16	-452.0	278.9	-1.62	0.1083	0	H2t
NUM17	1141.3	413.0	2.76	0.0068	0	H23t
NUM18	1691.8	357.8	4.73	<.0001	0	H12t
NUM19	93.0	282.9	0.33	0.7429	0	H0t
NUM20	1041.0	363.3	2.87	0.0051	0	H19t
NUM21	754.5	277.8	2.72	0.0078	0	H9t
NUM22	3682.7	475.5	7.74	<.0001	0	H30t
NUM23	2773.9	538.0	5.16	<.0001	0	H18t
NUM24	901.8	592.4	1.52	0.1311	0	H7t
NUM25	0.0	0.0	.	.	0	H27t
NUM26	-1280.5	237.6	-5.39	<.0001	0	S48
NUM27	-1832.6	237.2	-7.73	<.0001	0	A84

6.30 Malang

Parameter	Estimate	SE	T	p-value	Lag	Variable
AR1,1	0.2741	0.1059	2.59	0.0110	1	Y
AR1,2	0.4418	0.1068	4.14	<.0001	2	Y
AR2,1	0.8630	0.0809	10.67	<.0001	12	Y
NUM1	5.9	2.0	3.02	0.0032	0	t
NUM2	-27.5	106.2	-0.26	0.7963	0	H24tp1
NUM3	190.1	135.1	1.41	0.1626	0	H13tp1
NUM4	536.1	147.5	3.63	0.0004	0	H2tp1
NUM5	170.3	111.0	1.53	0.1282	0	H23tp1
NUM6	300.8	134.8	2.23	0.0278	0	H12tp1
NUM7	903.3	141.5	6.39	<.0001	0	H0tp1
NUM8	202.7	114.5	1.77	0.0798	0	H19tp1
NUM9	605.3	146.9	4.12	<.0001	0	H9tp1
NUM10	164.6	113.4	1.45	0.1500	0	H30tp1
NUM11	551.9	146.3	3.77	0.0003	0	H18tp1
NUM12	766.5	165.7	4.63	<.0001	0	H7tp1
NUM13	0.0	0.0	.	.	0	H27tp1
NUM14	397.4	101.3	3.92	0.0002	0	H24t
NUM15	309.9	119.3	2.60	0.0108	0	H13t
NUM16	-152.2	111.1	-1.37	0.1736	0	H2t
NUM17	429.2	151.2	2.84	0.0055	0	H23t
NUM18	112.3	136.9	0.82	0.4138	0	H12t
NUM19	-137.1	110.7	-1.24	0.2184	0	H0t
NUM20	808.9	134.5	6.02	<.0001	0	H19t
NUM21	264.3	109.7	2.41	0.0178	0	H9t
NUM22	1119.6	167.7	6.68	<.0001	0	H30t
NUM23	975.1	181.7	5.37	<.0001	0	H18t

NUM24	371.3	191.3	1.94	0.0551	0	H7t
NUM25	0.0	0.0	.	.	0	H27t
NUM26	-222.0	85.7	-2.59	0.0110	0	S48
NUM27	502.7	83.2	6.05	<.0001	0	A96

6.31 Kediri

Parameter	Estimate	SE	T	p-value	Lag	Variable
AR1,1	0.3539	0.0968	3.66	0.0004	2	Y
AR1,2	0.3675	0.0948	3.88	0.0002	3	Y
AR2,1	0.8239	0.0737	11.18	<.0001	12	Y
NUM1	8.2	2.4	3.48	0.0007	0	t
NUM2	-72.1	146.2	-0.49	0.6231	0	H24tp1
NUM3	333.7	183.7	1.82	0.0722	0	H13tp1
NUM4	883.8	199.1	4.44	<.0001	0	H2tp1
NUM5	172.2	154.8	1.11	0.2687	0	H23tp1
NUM6	404.7	182.5	2.22	0.0288	0	H12tp1
NUM7	1242.0	193.3	6.42	<.0001	0	H0tp1
NUM8	31.5	154.5	0.20	0.8391	0	H19tp1
NUM9	467.3	194.0	2.41	0.0178	0	H9tp1
NUM10	462.6	154.2	3.00	0.0034	0	H30tp1
NUM11	625.4	197.6	3.16	0.0020	0	H18tp1
NUM12	1356.8	223.6	6.07	<.0001	0	H7tp1
NUM13	0.0	0.0	.	.	0	H27tp1
NUM14	374.5	140.2	2.67	0.0088	0	H24t
NUM15	348.8	163.2	2.14	0.0350	0	H13t
NUM16	-203.8	148.7	-1.37	0.1736	0	H2t
NUM17	611.6	208.8	2.93	0.0042	0	H23t
NUM18	169.0	185.7	0.91	0.3648	0	H12t
NUM19	-304.3	149.7	-2.03	0.0447	0	H0t
NUM20	817.2	182.9	4.47	<.0001	0	H19t
NUM21	513.5	152.8	3.36	0.0011	0	H9t
NUM22	1594.9	218.0	7.32	<.0001	0	H30t
NUM23	1464.9	235.3	6.22	<.0001	0	H18t
NUM24	341.7	242.8	1.41	0.1623	0	H7t
NUM25	0.0	0.0	.	.	0	H27t
NUM26	-266.2	108.1	-2.46	0.0155	0	S48
NUM27	689.9	119.1	5.79	<.0001	0	A96

6.32 Jember

Parameter	Estimate	SE	T	p-value	Lag	Variable
AR1,1	0.3463	0.0989	3.50	0.0007	1	Y
AR1,2	0.4045	0.0937	4.32	<.0001	3	Y
AR2,1	0.7158	0.0848	8.44	<.0001	12	Y
NUM1	5.0	1.1	4.56	<.0001	0	t
NUM2	19.9	78.8	0.25	0.8011	0	H24tp1
NUM3	156.0	95.1	1.64	0.1042	0	H13tp1
NUM4	384.1	100.6	3.82	0.0002	0	H2tp1
NUM5	370.7	82.4	4.50	<.0001	0	H23tp1
NUM6	214.9	94.2	2.28	0.0246	0	H12tp1
NUM7	533.6	97.9	5.45	<.0001	0	H0tp1
NUM8	48.7	79.1	0.62	0.5392	0	H19tp1
NUM9	238.7	96.3	2.48	0.0149	0	H9tp1
NUM10	121.5	78.9	1.54	0.1264	0	H30tp1
NUM11	312.1	103.0	3.03	0.0031	0	H18tp1
NUM12	611.8	106.8	5.73	<.0001	0	H7tp1
NUM13	0.0	0.0	.	.	0	H27tp1
NUM14	308.7	76.4	4.04	0.0001	0	H24t
NUM15	159.8	87.4	1.83	0.0703	0	H13t
NUM16	-55.8	79.2	-0.70	0.4828	0	H2t
NUM17	266.7	102.4	2.60	0.0106	0	H23t
NUM18	81.7	95.0	0.86	0.3921	0	H12t
NUM19	-148.8	78.4	-1.90	0.0605	0	H0t
NUM20	165.3	93.1	1.78	0.0787	0	H19t
NUM21	181.3	81.0	2.24	0.0274	0	H9t
NUM22	735.2	104.4	7.04	<.0001	0	H30t
NUM23	726.8	110.2	6.60	<.0001	0	H18t

NUM24	215.8	111.1	1.94	0.0549	0	H7t
NUM25	0.0	0.0	.	.	0	H27t
NUM26	-198.7	63.0	-3.15	0.0021	0	S48
NUM27	268.3	67.3	3.99	0.0001	0	A96

6.33 Bali

Parameter	Estimate	SE	T	p-value	Lag	Variable
AR1,1	0.3047	0.0904	3.37	0.0011	1	Y
AR1,2	0.3672	0.0908	4.05	0.0001	3	Y
AR2,1	0.7922	0.0814	9.73	<.0001	12	Y
NUM1	12.8	2.8	4.55	<.0001	0	t
NUM2	211.1	215.5	0.98	0.3296	0	H24tp1
NUM3	206.3	268.6	0.77	0.4442	0	H13tp1
NUM4	218.5	288.4	0.76	0.4505	0	H2tp1
NUM5	-184.7	222.8	-0.83	0.4090	0	H23tp1
NUM6	-244.6	264.8	-0.92	0.3579	0	H12tp1
NUM7	458.2	277.1	1.65	0.1013	0	H0tp1
NUM8	-10.8	217.7	-0.05	0.9605	0	H19tp1
NUM9	-240.4	274.2	-0.88	0.3827	0	H9tp1
NUM10	-4.6	220.0	-0.02	0.9835	0	H30tp1
NUM11	125.2	282.6	0.44	0.6587	0	H18tp1
NUM12	643.1	311.5	2.06	0.0415	0	H7tp1
NUM13	0.0	0.0	.	.	0	H27tp1
NUM14	289.7	207.2	1.40	0.1652	0	H24t
NUM15	179.0	238.5	0.75	0.4546	0	H13t
NUM16	-271.1	213.8	-1.27	0.2077	0	H2t
NUM17	223.1	290.9	0.77	0.4449	0	H23t
NUM18	584.3	267.6	2.18	0.0313	0	H12t
NUM19	23.5	214.6	0.11	0.9132	0	H0t
NUM20	514.0	262.4	1.96	0.0528	0	H19t
NUM21	443.7	215.3	2.06	0.0419	0	H9t
NUM22	1252.5	306.6	4.09	<.0001	0	H30t
NUM23	1550.1	326.9	4.74	<.0001	0	H18t
NUM24	838.7	338.0	2.48	0.0147	0	H7t
NUM25	0.0	0.0	.	.	0	H27t
NUM26	-669.0	155.3	-4.31	<.0001	0	S48

6.34 Nusa Tenggara Barat

Parameter	Estimate	SE	T	p-value	Lag	Variable
AR1,1	0.3154	0.0966	3.27	0.0015	1	Y
AR1,2	0.4226	0.0965	4.38	<.0001	2	Y
AR2,1	0.4905	0.0935	5.25	<.0001	12	Y
NUM1	4.9	1.0	4.91	<.0001	0	t
NUM2	2.6	87.0	0.03	0.9758	0	H24tp1
NUM3	61.5	97.3	0.63	0.5286	0	H13tp1
NUM4	198.1	99.6	1.99	0.0494	0	H2tp1
NUM5	62.6	89.5	0.70	0.4856	0	H23tp1
NUM6	180.3	97.4	1.85	0.0670	0	H12tp1
NUM7	750.5	98.5	7.62	<.0001	0	H0tp1
NUM8	4.4	88.7	0.05	0.9604	0	H19tp1
NUM9	233.0	96.8	2.41	0.0179	0	H9tp1
NUM10	2.5	88.3	0.03	0.9772	0	H30tp1
NUM11	3.0	97.5	0.03	0.9757	0	H18tp1
NUM12	112.6	99.3	1.13	0.2595	0	H7tp1
NUM13	0.0	0.0	.	.	0	H27tp1
NUM14	66.0	86.7	0.76	0.4486	0	H24t
NUM15	71.3	95.1	0.75	0.4549	0	H13t
NUM16	-81.2	90.6	-0.90	0.3722	0	H2t
NUM17	39.2	102.9	0.38	0.7037	0	H23t
NUM18	34.8	96.8	0.36	0.7200	0	H12t
NUM19	17.9	88.1	0.20	0.8390	0	H0t
NUM20	614.7	96.8	6.35	<.0001	0	H19t
NUM21	110.0	88.1	1.25	0.2143	0	H9t
NUM22	449.9	98.7	4.56	<.0001	0	H30t
NUM23	280.4	99.6	2.81	0.0059	0	H18t
NUM24	13.3	99.6	0.13	0.8939	0	H7t

NUM25	0.0	0.0	.	.	0	H27t
NUM26	-192.7	78.5	-2.45	0.0158	0	S48

6.35 Nusa Tenggara Timur

Parameter	Estimate	SE	T	p-value	Lag	Variable
AR1,1	0.3514	0.1030	3.41	0.0010	1	Y
AR1,2	0.3947	0.1066	3.70	0.0004	2	Y
AR2,1	0.9828	0.0583	16.86	<.0001	12	Y
NUM1	4.1	1.9	2.19	0.0313	0	t
NUM2	-49.9	57.6	-0.87	0.3885	0	H24tp1
NUM3	81.7	74.7	1.09	0.2763	0	H13tp1
NUM4	111.4	84.1	1.33	0.1882	0	H2tp1
NUM5	-56.3	60.2	-0.94	0.3516	0	H23tp1
NUM6	56.5	74.0	0.76	0.4472	0	H12tp1
NUM7	243.8	78.4	3.11	0.0025	0	H0tp1
NUM8	26.4	65.0	0.41	0.6858	0	H19tp1
NUM9	13.5	90.2	0.15	0.8816	0	H9tp1
NUM10	105.4	66.2	1.59	0.1150	0	H30tp1
NUM11	81.9	91.0	0.90	0.3705	0	H18tp1
NUM12	177.1	109.8	1.61	0.1100	0	H7tp1
NUM13	0.0	0.0	.	.	0	H27tp1
NUM14	14.2	54.1	0.26	0.7927	0	H24t
NUM15	56.6	63.4	0.89	0.3739	0	H13t
NUM16	35.6	59.3	0.60	0.5494	0	H2t
NUM17	41.7	82.4	0.51	0.6135	0	H23t
NUM18	93.3	76.1	1.23	0.2230	0	H12t
NUM19	-22.2	60.7	-0.37	0.7157	0	H0t
NUM20	19.3	73.8	0.26	0.7943	0	H19t
NUM21	90.8	61.9	1.47	0.1456	0	H9t
NUM22	207.6	109.4	1.90	0.0608	0	H30t
NUM23	286.6	124.9	2.29	0.0240	0	H18t
NUM24	22.0	137.7	0.16	0.8731	0	H7t
NUM25	0.0	0.0	.	.	0	H27t
NUM26	-218.1	46.0	-4.74	<.0001	0	S49
NUM27	-210.5	49.4	-4.26	<.0001	0	A36
NUM28	132.9	43.4	3.06	0.0029	0	A41
NUM29	305.5	46.6	6.56	<.0001	0	A95
NUM30	954.3	66.8	14.30	<.0001	0	A96
NUM31	398.3	100.9	3.95	0.0002	0	A108
NUM32	221.7	48.1	4.61	<.0001	0	A114
NUM33	363.2	129.9	2.80	0.0063	0	A120
NUM34	606.8	155.8	3.89	0.0002	0	A132

6.36 Kalimantan Selatan

Parameter	Estimate	SE	T	p-value	Lag	Variable
AR1,1	0.3585	0.0986	3.64	0.0004	1	Y
AR1,2	0.3945	0.1009	3.91	0.0002	2	Y
AR2,1	0.9730	0.0594	16.37	<.0001	12	Y
NUM1	6.0	2.5	2.40	0.0180	0	t
NUM2	-5.1	79.3	-0.06	0.9490	0	H24tp1
NUM3	106.1	103.1	1.03	0.3056	0	H13tp1
NUM4	374.0	113.4	3.30	0.0013	0	H2tp1
NUM5	-32.0	83.0	-0.39	0.7009	0	H23tp1
NUM6	31.2	101.9	0.31	0.7605	0	H12tp1
NUM7	532.4	108.1	4.92	<.0001	0	H0tp1
NUM8	88.3	88.9	0.99	0.3229	0	H19tp1
NUM9	600.2	121.4	4.95	<.0001	0	H9tp1
NUM10	211.2	91.4	2.31	0.0229	0	H30tp1
NUM11	175.5	124.0	1.42	0.1600	0	H18tp1
NUM12	765.0	145.8	5.25	<.0001	0	H7tp1
NUM13	0.0	0.0	.	.	0	H27tp1
NUM14	261.3	75.1	3.48	0.0007	0	H24t
NUM15	224.8	89.2	2.52	0.0133	0	H13t
NUM16	-132.6	83.5	-1.59	0.1153	0	H2t
NUM17	8.9	115.4	0.08	0.9386	0	H23t
NUM18	204.2	104.0	1.96	0.0525	0	H12t

NUM19	-99.3	83.1	-1.19	0.2349	0	H0t
NUM20	474.4	101.9	4.66	<.0001	0	H19t
NUM21	434.6	85.6	5.08	<.0001	0	H9t
NUM22	1131.6	146.7	7.71	<.0001	0	H30t
NUM23	931.6	167.2	5.57	<.0001	0	H18t
NUM24	364.8	184.9	1.97	0.0512	0	H7t
NUM25	0.0	0.0	.	.	0	H27t
NUM26	-315.3	66.7	-4.72	<.0001	0	S48
NUM27	626.8	64.0	9.79	<.0001	0	A95
NUM28	709.4	60.7	11.69	<.0001	0	A96

6.37 Kalimantan Barat

Parameter	Estimate	SE	T	p-value	Lag	Variable
AR1,1	0.5052	0.0900	5.62	<.0001	2	Y
AR2,1	0.9299	0.0676	13.75	<.0001	12	Y
NUM1	5.0	1.9	2.58	0.0114	0	t
NUM2	36.2	135.2	0.27	0.7893	0	H24tp1
NUM3	223.4	174.0	1.28	0.2021	0	H13tp1
NUM4	487.4	191.1	2.55	0.0122	0	H2tp1
NUM5	53.7	140.8	0.38	0.7039	0	H23tp1
NUM6	164.7	172.6	0.95	0.3423	0	H12tp1
NUM7	552.6	182.7	3.03	0.0031	0	H0tp1
NUM8	51.5	151.1	0.34	0.7340	0	H19tp1
NUM9	277.4	199.7	1.39	0.1678	0	H9tp1
NUM10	398.8	151.8	2.63	0.0099	0	H30tp1
NUM11	718.5	201.6	3.56	0.0006	0	H18tp1
NUM12	1167.9	237.0	4.93	<.0001	0	H7tp1
NUM13	0.0	0.0	.	.	0	H27tp1
NUM14	262.5	127.3	2.06	0.0417	0	H24t
NUM15	177.6	149.6	1.19	0.2379	0	H13t
NUM16	-103.3	135.8	-0.76	0.4485	0	H2t
NUM17	390.0	192.6	2.02	0.0455	0	H23t
NUM18	284.5	178.4	1.59	0.1138	0	H12t
NUM19	-110.6	144.1	-0.77	0.4446	0	H0t
NUM20	385.5	173.4	2.22	0.0284	0	H19t
NUM21	-33.3	142.5	-0.23	0.8155	0	H9t
NUM22	793.6	234.0	3.39	0.0010	0	H30t
NUM23	711.5	260.5	2.73	0.0074	0	H18t
NUM24	149.5	281.8	0.53	0.5970	0	H7t
NUM25	0.0	0.0	.	.	0	H27t
NUM26	-229.3	78.1	-2.94	0.0041	0	S49
NUM27	829.1	103.3	8.02	<.0001	0	A96

6.38 Kalimantan Timur

Parameter	Estimate	SE	T	p-value	Lag	Variable
AR1,1	0.5135	0.0889	5.78	<.0001	2	Y
AR2,1	0.9818	0.0546	17.97	<.0001	12	Y
NUM1	7.8	2.9	2.73	0.0075	0	t
NUM2	126.5	164.1	0.77	0.4427	0	H24tp1
NUM3	213.5	212.4	1.01	0.3170	0	H13tp1
NUM4	705.4	233.9	3.02	0.0032	0	H2tp1
NUM5	131.9	171.9	0.77	0.4447	0	H23tp1
NUM6	276.9	211.0	1.31	0.1923	0	H12tp1
NUM7	985.0	222.2	4.43	<.0001	0	H0tp1
NUM8	72.3	187.9	0.38	0.7011	0	H19tp1
NUM9	396.4	254.4	1.56	0.1222	0	H9tp1
NUM10	293.7	188.9	1.55	0.1231	0	H30tp1
NUM11	316.1	255.6	1.24	0.2189	0	H18tp1
NUM12	1199.0	305.5	3.93	0.0002	0	H7tp1
NUM13	0.0	0.0	.	.	0	H27tp1
NUM14	577.0	154.3	3.74	0.0003	0	H24t
NUM15	428.1	180.0	2.38	0.0193	0	H13t
NUM16	-147.9	162.6	-0.91	0.3651	0	H2t
NUM17	622.2	235.6	2.64	0.0096	0	H23t
NUM18	484.1	217.9	2.22	0.0285	0	H12t
NUM19	-117.3	175.8	-0.67	0.5060	0	H0t

NUM20	756.3	211.5	3.58	0.0005	0	H19t
NUM21	164.1	174.4	0.94	0.3489	0	H9t
NUM22	1227.8	304.7	4.03	0.0001	0	H30t
NUM23	1222.9	346.7	3.53	0.0006	0	H18t
NUM24	295.1	383.1	0.77	0.4428	0	H7t
NUM25	0.0	0.0	.	.	0	H27t
NUM26	-257.5	93.2	-2.76	0.0068	0	S41
NUM27	1421.0	124.2	11.44	<.0001	0	A96

6.39 Kalimantan Tengah

Parameter	Estimate	SE	T	p-value	Lag	Variable
AR1,1	0.4961	0.0872	5.69	<.0001	1	Y
AR2,1	1.0000	0.0494	20.26	<.0001	12	Y
NUM1	3.5	1.4	2.49	0.0143	0	t
NUM2	89.7	81.4	1.10	0.2729	0	H24tp1
NUM3	99.7	103.8	0.96	0.3392	0	H13tp1
NUM4	145.1	112.1	1.29	0.1987	0	H2tp1
NUM5	3.9	81.9	0.05	0.9617	0	H23tp1
NUM6	112.0	103.9	1.08	0.2838	0	H12tp1
NUM7	472.3	110.9	4.26	<.0001	0	H0tp1
NUM8	-56.8	88.0	-0.65	0.5201	0	H19tp1
NUM9	86.9	122.1	0.71	0.4780	0	H9tp1
NUM10	177.4	91.9	1.93	0.0563	0	H30tp1
NUM11	155.2	127.4	1.22	0.2260	0	H18tp1
NUM12	542.2	154.9	3.50	0.0007	0	H7tp1
NUM13	0.0	0.0	.	.	0	H27tp1
NUM14	101.0	76.4	1.32	0.1895	0	H24t
NUM15	91.2	88.3	1.03	0.3043	0	H13t
NUM16	29.6	77.1	0.38	0.7017	0	H2t
NUM17	140.8	111.2	1.27	0.2084	0	H23t
NUM18	177.9	103.9	1.71	0.0899	0	H12t
NUM19	-50.7	82.1	-0.62	0.5380	0	H0t
NUM20	521.2	103.2	5.05	<.0001	0	H19t
NUM21	332.1	83.8	3.96	0.0001	0	H9t
NUM22	555.6	153.2	3.63	0.0005	0	H30t
NUM23	602.6	177.1	3.40	0.0010	0	H18t
NUM24	-142.1	198.6	-0.72	0.4759	0	H7t
NUM25	0.0	0.0	.	.	0	H27t
NUM26	650.8	58.7	11.09	<.0001	0	S95
NUM27	-499.3	58.7	-8.51	<.0001	0	S97
NUM28	328.9	57.1	5.77	<.0001	0	A60
NUM29	306.6	94.4	3.25	0.0016	0	A132

6.40 Balikpapan

Parameter	Estimate	SE	T	p-value	Lag	Variable
AR1,1	0.1540	0.1024	1.50	0.1357	1	Y
AR1,2	0.3516	0.1018	3.45	0.0008	2	Y
AR1,3	0.2668	0.1156	2.31	0.0231	3	Y
AR1,4	-0.0593	0.1004	-0.59	0.5560	6	Y
AR2,1	1.0000	0.0393	25.45	<.0001	12	Y
NUM1	2.4	2.5	0.97	0.3321	0	t
NUM2	42.0	79.6	0.53	0.5992	0	H24tp1
NUM3	131.2	103.0	1.27	0.2056	0	H13tp1
NUM4	429.8	112.8	3.81	0.0002	0	H2tp1
NUM5	76.7	80.3	0.96	0.3416	0	H23tp1
NUM6	37.4	100.8	0.37	0.7112	0	H12tp1
NUM7	702.5	108.2	6.49	<.0001	0	H0tp1
NUM8	63.2	89.0	0.71	0.4795	0	H19tp1
NUM9	394.2	125.6	3.14	0.0022	0	H9tp1
NUM10	-14.0	88.6	-0.16	0.8751	0	H30tp1
NUM11	253.7	124.1	2.04	0.0435	0	H18tp1
NUM12	581.8	150.4	3.87	0.0002	0	H7tp1
NUM13	0.0	0.0	.	.	0	H27tp1
NUM14	255.5	74.5	3.43	0.0009	0	H24t
NUM15	175.1	86.7	2.02	0.0461	0	H13t
NUM16	-193.4	76.0	-2.55	0.0125	0	H2t

NUM17	432.6	113.1	3.82	0.0002	0	H23t
NUM18	249.6	103.7	2.41	0.0179	0	H12t
NUM19	-103.3	81.7	-1.26	0.2088	0	H0t
NUM20	539.6	101.9	5.30	<.0001	0	H19t
NUM21	379.1	84.4	4.49	<.0001	0	H9t
NUM22	779.5	151.1	5.16	<.0001	0	H30t
NUM23	639.6	173.6	3.68	0.0004	0	H18t
NUM24	193.7	193.5	1.00	0.3191	0	H7t
NUM25	0.0	0.0	.	.	0	H27t
NUM26	840.3	65.4	12.86	<.0001	0	A95
NUM27	1042.6	63.0	16.54	<.0001	0	A96

6.41 Sulawesi Selatan

Parameter	Estimate	SE	T	p-value	Lag	Variable
AR1,1	0.2788	0.0939	2.97	0.0037	1	Y
AR1,2	0.4278	0.0945	4.53	<.0001	2	Y
AR2,1	0.9061	0.0638	14.20	<.0001	12	Y
NUM1	11.8	3.4	3.46	0.0008	0	t
NUM2	-80.7	170.3	-0.47	0.6365	0	H24tp1
NUM3	265.3	219.3	1.21	0.2291	0	H13tp1
NUM4	623.8	240.7	2.59	0.0109	0	H2tp1
NUM5	82.7	175.4	0.47	0.6381	0	H23tp1
NUM6	53.0	216.5	0.24	0.8072	0	H12tp1
NUM7	1248.2	228.6	5.46	<.0001	0	H0tp1
NUM8	1.8	186.4	0.01	0.9924	0	H19tp1
NUM9	-79.7	245.7	-0.32	0.7464	0	H9tp1
NUM10	86.4	184.9	0.47	0.6414	0	H30tp1
NUM11	409.7	243.5	1.68	0.0955	0	H18tp1
NUM12	1158.2	282.2	4.10	<.0001	0	H7tp1
NUM13	0.0	0.0	.	.	0	H27tp1
NUM14	295.9	160.5	1.84	0.0682	0	H24t
NUM15	392.4	187.8	2.09	0.0392	0	H13t
NUM16	-72.0	170.1	-0.42	0.6729	0	H2t
NUM17	590.0	241.9	2.44	0.0164	0	H23t
NUM18	502.2	224.8	2.23	0.0276	0	H12t
NUM19	-133.6	183.7	-0.73	0.4687	0	H0t
NUM20	457.1	216.5	2.11	0.0372	0	H19t
NUM21	325.7	176.1	1.85	0.0673	0	H9t
NUM22	1495.5	284.4	5.26	<.0001	0	H30t
NUM23	1281.7	311.7	4.11	<.0001	0	H18t
NUM24	334.2	334.5	1.00	0.3201	0	H7t
NUM25	0.0	0.0	.	.	0	H27t
NUM26	-394.2	123.5	-3.19	0.0019	0	S49
NUM27	-871.6	133.3	-6.54	<.0001	0	A84

6.42 Sulawesi Tengah

Parameter	Estimate	SE	T	p-value	Lag	Variable
AR1,1	0.4656	0.0950	4.90	<.0001	2	Y
AR2,1	0.9784	0.0497	19.69	<.0001	12	Y
NUM1	3.5	1.1	3.33	0.0012	0	t
NUM2	57.0	68.3	0.83	0.4061	0	H24tp1
NUM3	148.7	88.4	1.68	0.0957	0	H13tp1
NUM4	279.0	97.3	2.87	0.0050	0	H2tp1
NUM5	34.6	70.7	0.49	0.6254	0	H23tp1
NUM6	30.6	87.3	0.35	0.7263	0	H12tp1
NUM7	430.0	92.3	4.66	<.0001	0	H0tp1
NUM8	92.5	77.9	1.19	0.2380	0	H19tp1
NUM9	89.4	106.9	0.84	0.4050	0	H9tp1
NUM10	117.4	78.4	1.50	0.1372	0	H30tp1
NUM11	80.4	105.1	0.77	0.4460	0	H18tp1
NUM12	276.5	126.1	2.19	0.0306	0	H7tp1
NUM13	0.0	0.0	.	.	0	H27tp1
NUM14	123.9	64.0	1.93	0.0558	0	H24t
NUM15	125.0	74.9	1.67	0.0984	0	H13t
NUM16	-65.6	67.7	-0.97	0.3353	0	H2t
NUM17	232.6	97.9	2.38	0.0194	0	H23t

NUM18	186.1	90.4	2.06	0.0421	0	H12t
NUM19	-43.9	72.6	-0.61	0.5465	0	H0t
NUM20	323.0	87.7	3.68	0.0004	0	H19t
NUM21	114.8	76.1	1.51	0.1344	0	H9t
NUM22	471.4	128.6	3.67	0.0004	0	H30t
NUM23	337.5	146.2	2.31	0.0230	0	H18t
NUM24	199.0	162.4	1.22	0.2235	0	H7t
NUM25	0.0	0.0	.	.	0	H27t
NUM26	-97.5	37.2	-2.62	0.0101	0	S49
NUM27	472.7	56.7	8.34	<.0001	0	A95
NUM28	540.3	51.6	10.48	<.0001	0	A96
NUM29	-212.3	54.5	-3.90	0.0002	0	A119

6.43 Sulawesi Utara

Parameter	Estimate	SE	T	p-value	Lag	Variable
AR1,1	0.4689	0.0834	5.62	<.0001	1	Y
AR1,2	0.3408	0.0834	4.09	<.0001	3	Y
AR2,1	0.9876	0.0520	18.98	<.0001	12	Y
NUM1	67.9	103.3	0.66	0.5125	0	H24tp1
NUM2	79.5	132.4	0.60	0.5492	0	H13tp1
NUM3	125.1	143.3	0.87	0.3847	0	H2tp1
NUM4	44.6	103.0	0.43	0.6656	0	H23tp1
NUM5	-50.9	130.8	-0.39	0.6979	0	H12tp1
NUM6	274.7	139.0	1.98	0.0507	0	H0tp1
NUM7	10.8	110.2	0.10	0.9218	0	H19tp1
NUM8	-25.7	153.2	-0.17	0.8668	0	H9tp1
NUM9	-39.6	111.6	-0.35	0.7235	0	H30tp1
NUM10	-151.8	157.3	-0.96	0.3368	0	H18tp1
NUM11	56.0	191.1	0.29	0.7701	0	H7tp1
NUM12	0.0	0.0	.	.	0	H27tp1
NUM13	139.0	97.1	1.43	0.1552	0	H24t
NUM14	60.6	112.1	0.54	0.5896	0	H13t
NUM15	-158.1	97.1	-1.63	0.1064	0	H2t
NUM16	250.3	142.6	1.75	0.0822	0	H23t
NUM17	292.0	131.9	2.21	0.0290	0	H12t
NUM18	-1.4	103.1	-0.01	0.9894	0	H0t
NUM19	225.0	129.5	1.74	0.0852	0	H19t
NUM20	243.1	102.4	2.37	0.0194	0	H9t
NUM21	428.3	188.4	2.27	0.0251	0	H30t
NUM22	514.7	217.4	2.37	0.0197	0	H18t
NUM23	327.5	241.4	1.36	0.1778	0	H7t
NUM24	0.0	0.0	.	.	0	H27t

6.44 Sulawesi Tenggara

Parameter	Estimate	SE	T	p-value	Lag	Variable
AR1,1	0.4178	0.0903	4.63	<.0001	1	Y
AR1,2	0.2775	0.0926	3.00	0.0034	4	Y
AR2,1	0.9093	0.0583	15.61	<.0001	12	Y
NUM1	3.9	1.4	2.72	0.0077	0	t
NUM2	49.3	76.3	0.65	0.5196	0	H24tp1
NUM3	88.1	97.1	0.91	0.3666	0	H13tp1
NUM4	227.7	104.9	2.17	0.0322	0	H2tp1
NUM5	-22.8	78.1	-0.29	0.7708	0	H23tp1
NUM6	75.7	95.4	0.79	0.4291	0	H12tp1
NUM7	499.1	100.9	4.94	<.0001	0	H0tp1
NUM8	-50.9	79.1	-0.64	0.5210	0	H19tp1
NUM9	-52.9	105.4	-0.50	0.6170	0	H9tp1
NUM10	22.9	80.8	0.28	0.7777	0	H30tp1
NUM11	1.4	109.0	0.01	0.9899	0	H18tp1
NUM12	319.9	127.3	2.51	0.0135	0	H7tp1
NUM13	0.0	0.0	.	.	0	H27tp1
NUM14	72.5	71.7	1.01	0.3148	0	H24t
NUM15	81.5	82.9	0.98	0.3278	0	H13t
NUM16	-1.4	72.3	-0.02	0.9843	0	H2t
NUM17	203.3	105.3	1.93	0.0563	0	H23t
NUM18	278.1	96.7	2.88	0.0049	0	H12t

NUM19	-7.7	76.4	-0.10	0.9199	0	H0t
NUM20	355.3	94.6	3.75	0.0003	0	H19t
NUM21	296.1	76.3	3.88	0.0002	0	H9t
NUM22	319.8	124.5	2.57	0.0116	0	H30t
NUM23	194.6	138.5	1.40	0.1631	0	H18t
NUM24	-82.3	148.9	-0.55	0.5816	0	H7t
NUM25	0.0	0.0	.	.	0	H27t
NUM26	-176.2	51.2	-3.44	0.0008	0	S49

6.45 Maluku

Parameter	Estimate	SE	T	p-value	Lag	Variable
AR1,1	0.2612	0.1006	2.60	0.0108	1	Y
AR1,2	0.3618	0.1009	3.58	0.0005	3	Y
AR2,1	0.9778	0.0501	19.52	<.0001	12	Y
NUM1	2.5	1.3	1.99	0.0489	0	t
NUM2	100.9	60.6	1.66	0.0993	0	H24tp1
NUM3	93.7	78.1	1.20	0.2330	0	H13tp1
NUM4	142.6	85.4	1.67	0.0981	0	H2tp1
NUM5	11.6	60.2	0.19	0.8479	0	H23tp1
NUM6	-88.2	76.3	-1.16	0.2507	0	H12tp1
NUM7	141.4	81.3	1.74	0.0851	0	H0tp1
NUM8	4.8	65.0	0.07	0.9414	0	H19tp1
NUM9	66.0	93.2	0.71	0.4805	0	H9tp1
NUM10	-37.3	65.7	-0.57	0.5716	0	H30tp1
NUM11	16.4	91.3	0.18	0.8576	0	H18tp1
NUM12	66.8	110.8	0.60	0.5477	0	H7tp1
NUM13	0.0	0.0	.	.	0	H27tp1
NUM14	50.2	56.9	0.88	0.3800	0	H24t
NUM15	68.1	65.7	1.04	0.3024	0	H13t
NUM16	-46.5	57.5	-0.81	0.4204	0	H2t
NUM17	171.8	86.2	1.99	0.0488	0	H23t
NUM18	160.4	77.7	2.06	0.0417	0	H12t
NUM19	57.2	60.5	0.95	0.3468	0	H0t
NUM20	114.5	76.9	1.49	0.1399	0	H19t
NUM21	153.5	61.8	2.48	0.0147	0	H9t
NUM22	230.9	109.9	2.10	0.0382	0	H30t
NUM23	68.0	126.3	0.54	0.5916	0	H18t
NUM24	74.3	140.0	0.53	0.5969	0	H7t
NUM25	0.0	0.0	.	.	0	H27t
NUM26	-107.5	38.1	-2.82	0.0058	0	S49
NUM27	384.6	50.4	7.64	<.0001	0	A95
NUM28	437.9	49.3	8.88	<.0001	0	A96

6.46 Maluku Utara

Parameter	Estimate	SE	T	p-value	Lag	Variable
AR1,1	0.3593	0.0974	3.69	0.0004	1	Y
AR2,1	0.9473	0.0539	17.57	<.0001	12	Y
NUM1	1.6	0.4	3.75	0.0003	0	t
NUM2	22.7	38.4	0.59	0.5549	0	H24tp1
NUM3	18.8	48.8	0.38	0.7017	0	H13tp1
NUM4	97.5	53.0	1.84	0.0685	0	H2tp1
NUM5	35.4	37.8	0.94	0.3510	0	H23tp1
NUM6	36.3	48.2	0.75	0.4528	0	H12tp1
NUM7	172.1	50.8	3.39	0.0010	0	H0tp1
NUM8	-30.9	39.9	-0.77	0.4413	0	H19tp1
NUM9	20.4	54.9	0.37	0.7106	0	H9tp1
NUM10	-28.6	40.7	-0.70	0.4826	0	H30tp1
NUM11	-39.4	56.3	-0.70	0.4853	0	H18tp1
NUM12	164.9	67.8	2.43	0.0167	0	H7tp1
NUM13	0.0	0.0	.	.	0	H27tp1
NUM14	60.1	35.7	1.69	0.0948	0	H24t
NUM15	27.2	41.1	0.66	0.5090	0	H13t
NUM16	-27.1	35.7	-0.76	0.4487	0	H2t
NUM17	93.4	52.8	1.77	0.0796	0	H23t
NUM18	146.2	48.7	3.00	0.0034	0	H12t
NUM19	-18.1	37.9	-0.48	0.6344	0	H0t

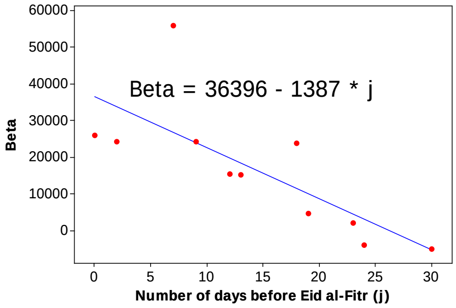
NUM20	111.0	47.3	2.34	0.0210	0	H19t
NUM21	170.2	37.7	4.52	<.0001	0	H9t
NUM22	155.4	65.9	2.36	0.0202	0	H30t
NUM23	92.6	74.7	1.24	0.2178	0	H18t
NUM24	16.0	82.0	0.19	0.8458	0	H7t
NUM25	0.0	0.0	.	.	0	H27t
NUM26	-61.2	19.0	-3.23	0.0017	0	S49
NUM27	-144.4	27.8	-5.20	<.0001	0	A84

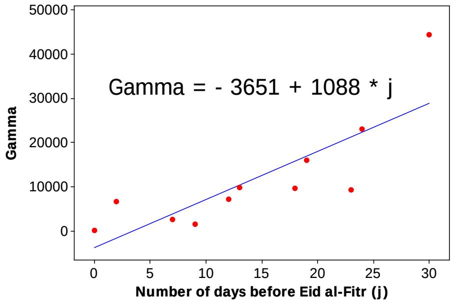
6.47 Papua

Parameter	Estimate	SE	T	p-value	Lag	Variable
AR1,1	0.1794	0.1168	1.54	0.1278	1	Y
AR1,2	0.0665	0.1119	0.59	0.5539	2	Y
AR1,3	0.0560	0.1100	0.51	0.6121	3	Y
AR1,4	0.0452	0.1104	0.41	0.6830	5	Y
AR1,5	0.0279	0.1101	0.25	0.8009	6	Y
AR2,1	1.0000	0.0405	24.72	<.0001	12	Y
NUM1	12.2	2.5	4.80	<.0001	0	t
NUM2	33.3	179.7	0.19	0.8533	0	H24tp1
NUM3	-78.5	229.8	-0.34	0.7333	0	H13tp1
NUM4	-77.3	251.8	-0.31	0.7594	0	H2tp1
NUM5	60.5	176.9	0.34	0.7332	0	H23tp1
NUM6	-132.9	224.5	-0.59	0.5551	0	H12tp1
NUM7	274.1	237.9	1.15	0.2521	0	H0tp1
NUM8	43.9	194.6	0.23	0.8219	0	H19tp1
NUM9	-168.5	273.9	-0.62	0.5399	0	H9tp1
NUM10	-103.1	199.8	-0.52	0.6070	0	H30tp1
NUM11	265.8	277.4	0.96	0.3404	0	H18tp1
NUM12	611.0	336.9	1.81	0.0728	0	H7tp1
NUM13	0.0	0.0	.	.	0	H27tp1
NUM14	116.8	168.0	0.70	0.4887	0	H24t
NUM15	-87.6	193.2	-0.45	0.6513	0	H13t
NUM16	-182.7	167.8	-1.09	0.2788	0	H2t
NUM17	178.1	252.8	0.70	0.4826	0	H23t
NUM18	-62.8	231.0	-0.27	0.7862	0	H12t
NUM19	-324.9	179.1	-1.81	0.0727	0	H0t
NUM20	-48.5	225.6	-0.21	0.8302	0	H19t
NUM21	-151.4	180.9	-0.84	0.4049	0	H9t
NUM22	573.9	338.4	1.70	0.0931	0	H30t
NUM23	471.7	389.2	1.21	0.2285	0	H18t
NUM24	28.5	437.5	0.07	0.9481	0	H7t
NUM25	0.0	0.0	.	.	0	H27t
NUM26	-362.6	86.6	-4.19	<.0001	0	S49
NUM27	1673.6	148.7	11.26	<.0001	0	A96
NUM28	516.7	137.7	3.75	0.0003	0	A120

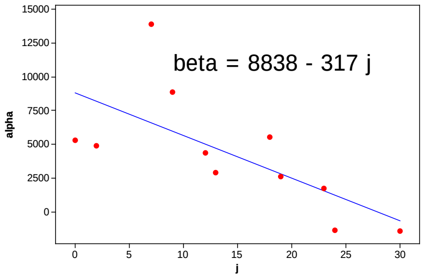
Appendix 7. Second Level ARIMAX Model for Currency Inflow

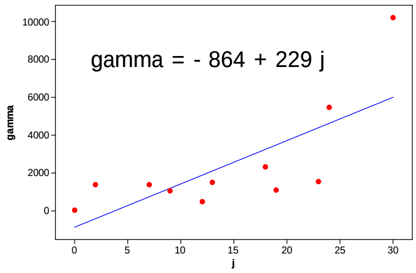
7.1 Indonesia



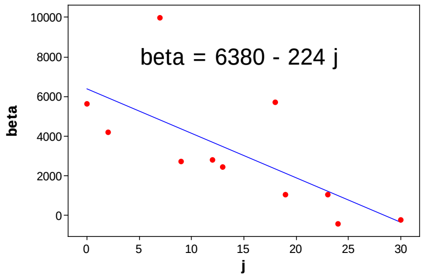


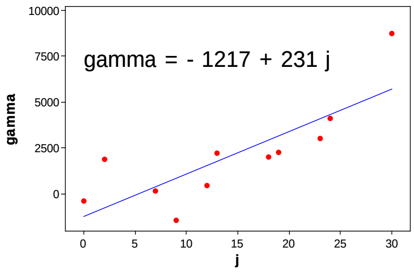
7.2 Jakarta



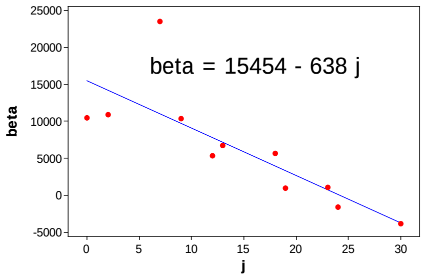


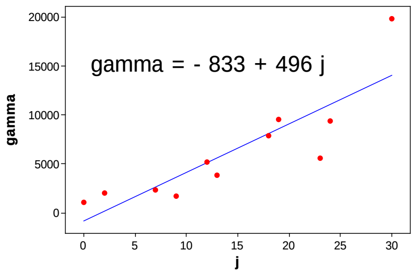
7.3 Sumatera



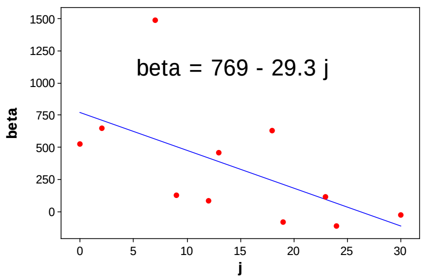


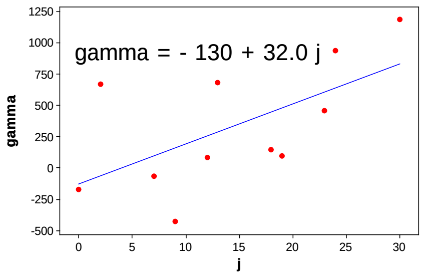
7.4 Jawa



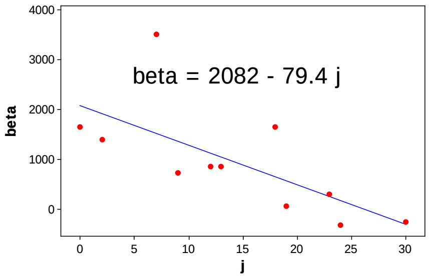


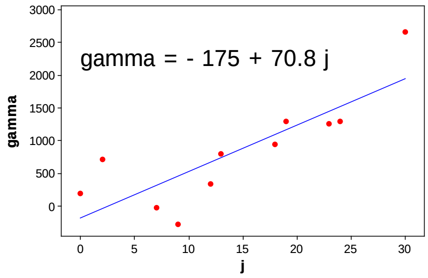
7.5 Balinusra



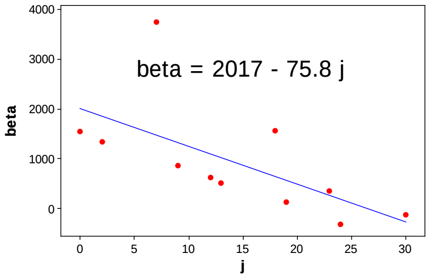


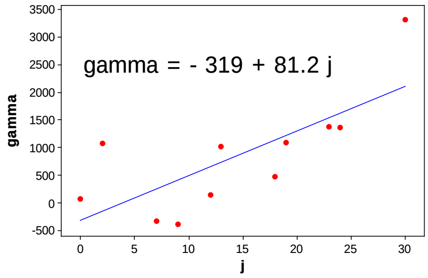
7.6 Kalimantan



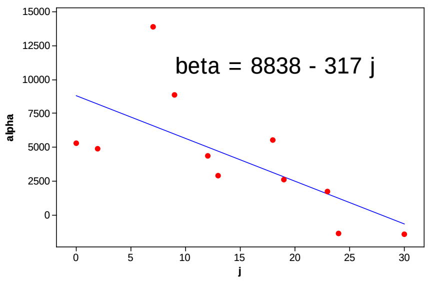


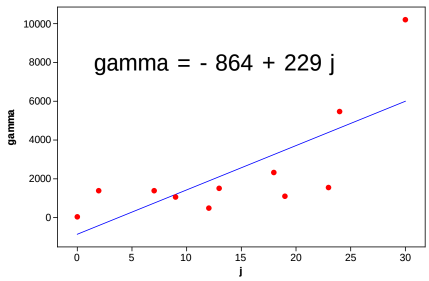
7.7 Sulampua



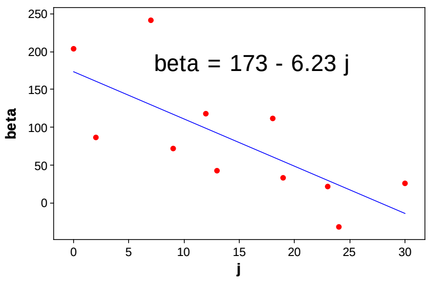


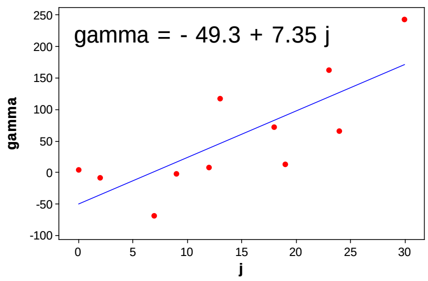
7.8 Jakarta



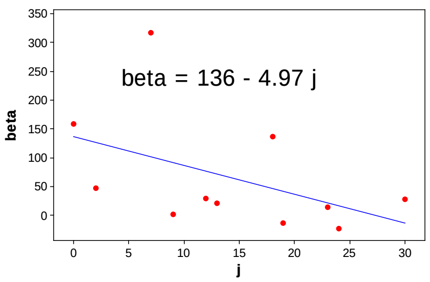


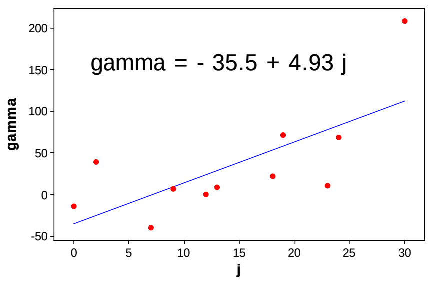
7.9 Aceh



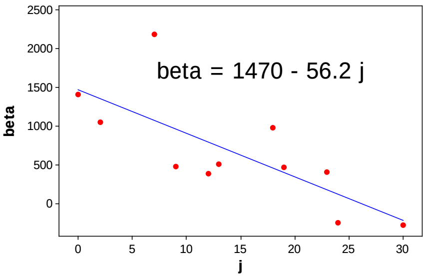


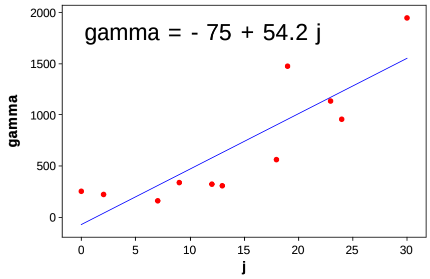
7.10 Lhokseumawe



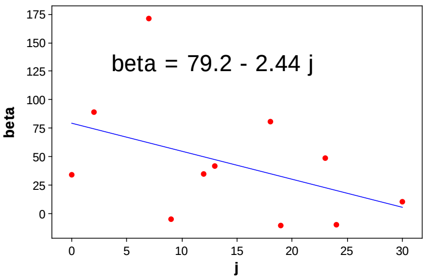


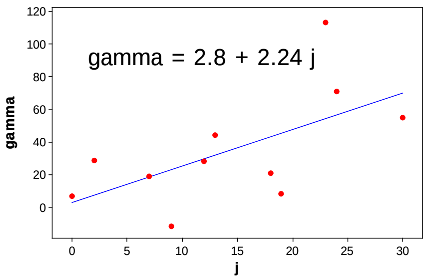
7.11 Sumatera Utara



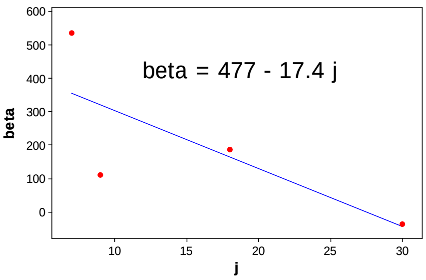


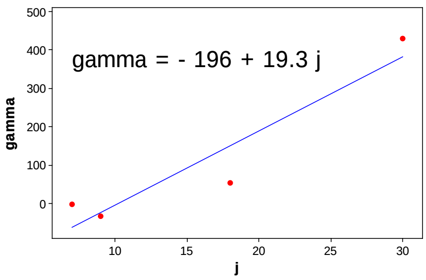
7.12 Sibolga



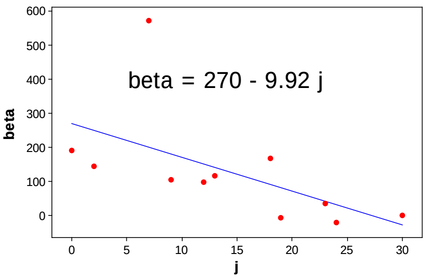


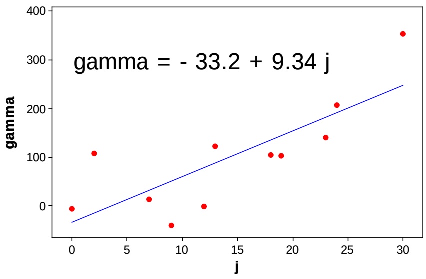
7.13 Pematang Siantar



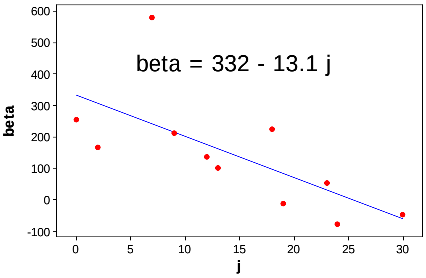


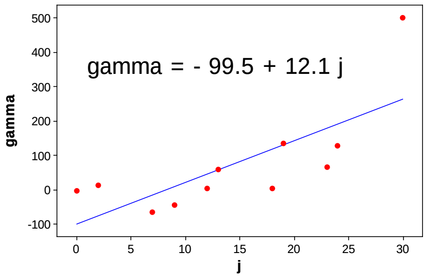
7.14 Bengkulu



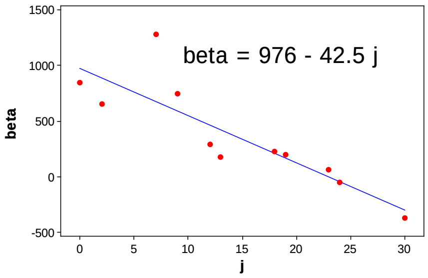


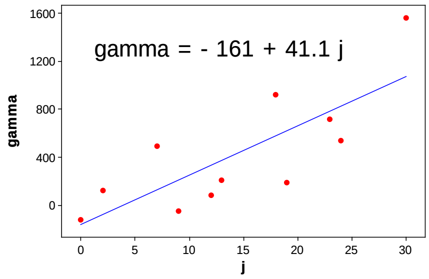
7.15 Jambi



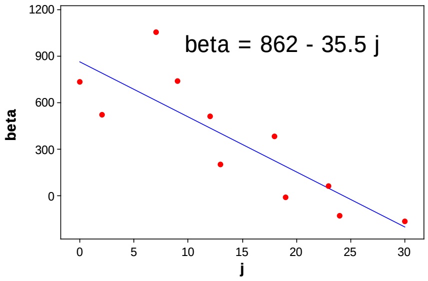


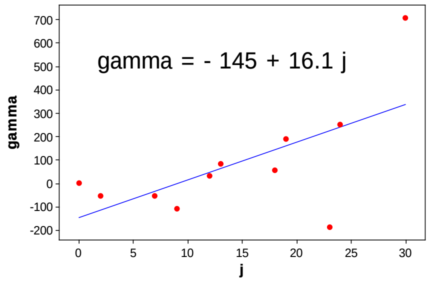
7.16 Sumatera Barat



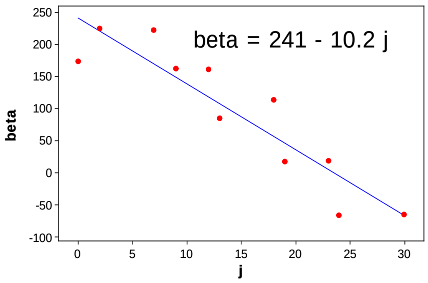


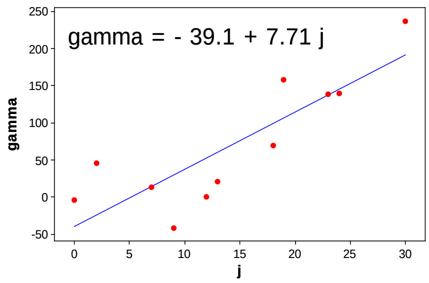
7.17 Riau



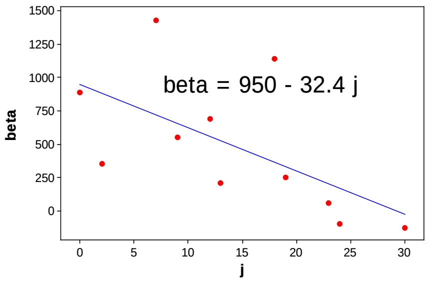


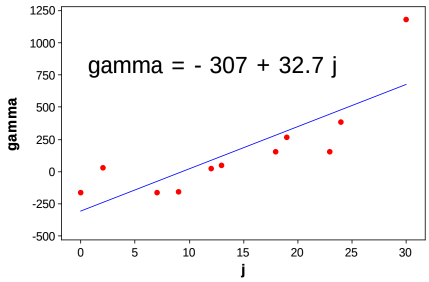
7.18 Kepulauan Riau



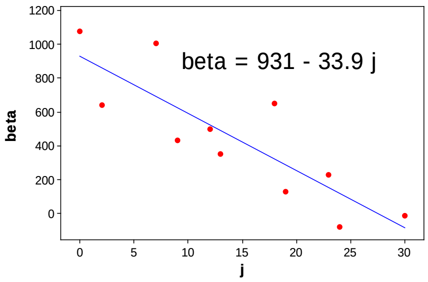


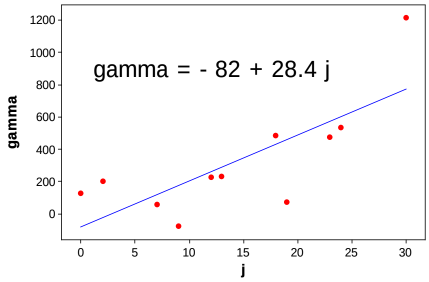
7.19 Sumatera Selatan



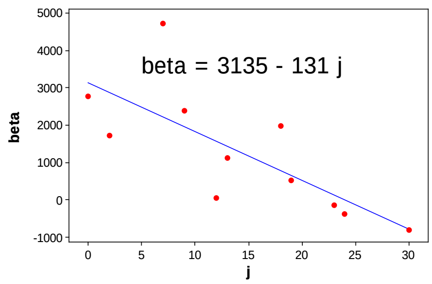


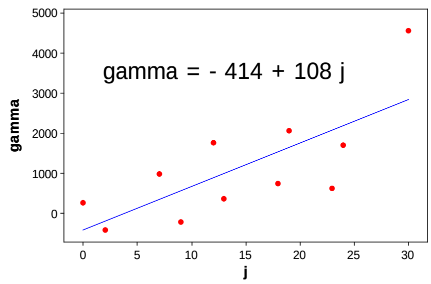
7.20 Lampung



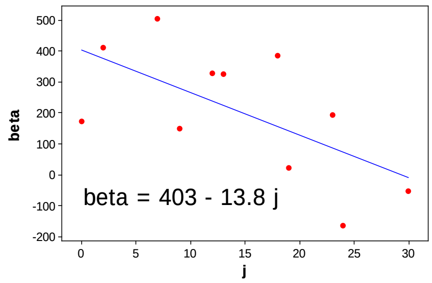


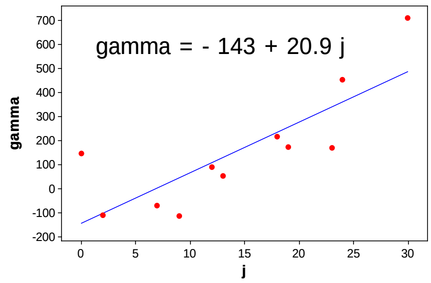
7.21 Jawa Barat



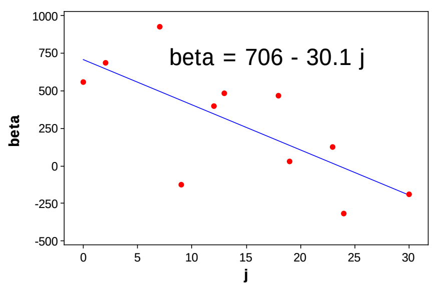


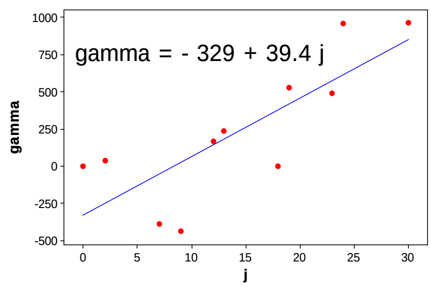
7.22 Tasikmalaya



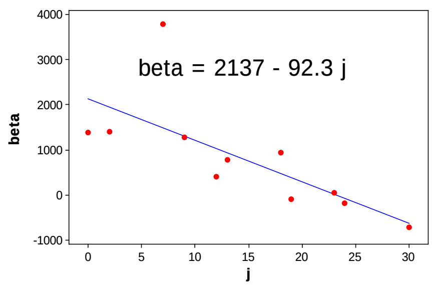


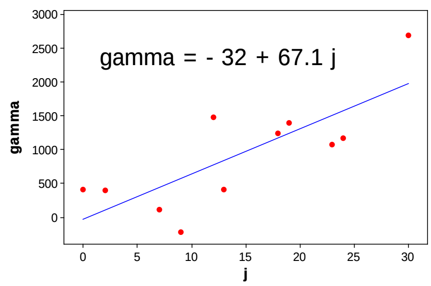
7.23 Cirebon



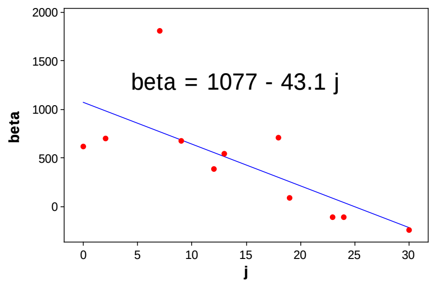


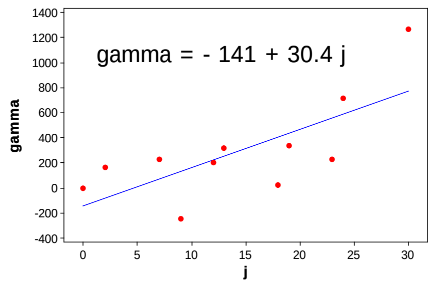
7.24 Jawa Tengah



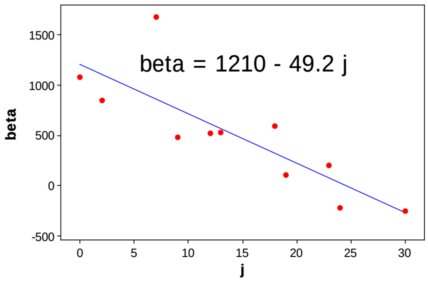


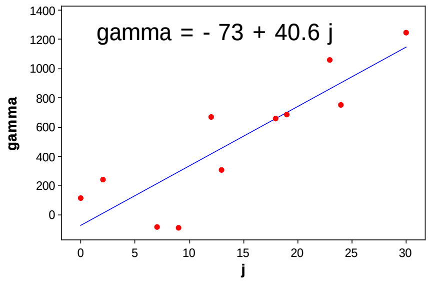
7.25 Yogyakarta





7.26 Solo





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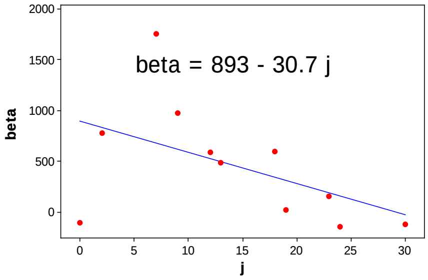
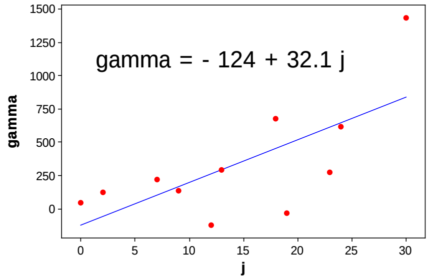
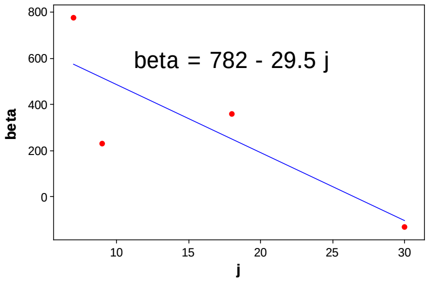
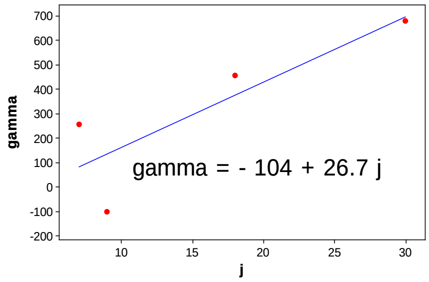


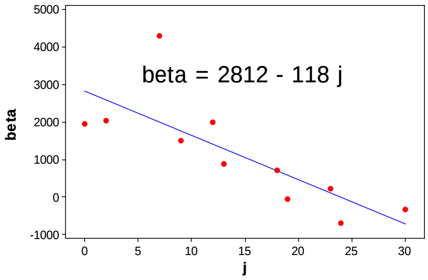


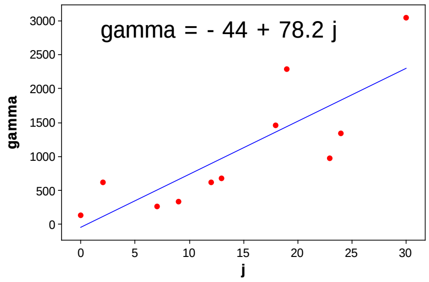
7.28 Tegal



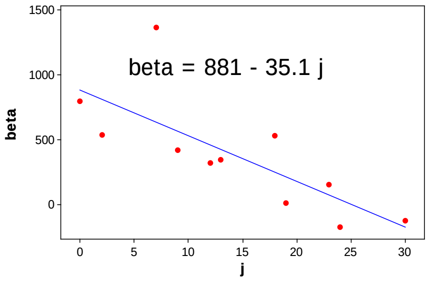


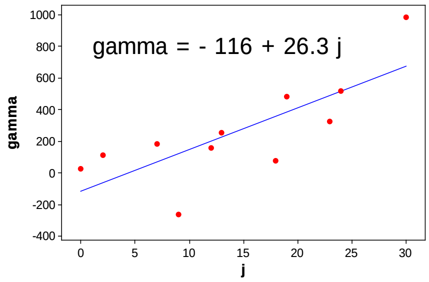
7.29 Jawa Timur





7.30 Malang





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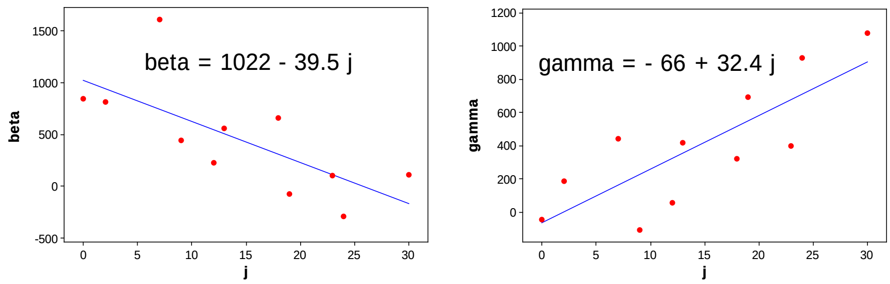
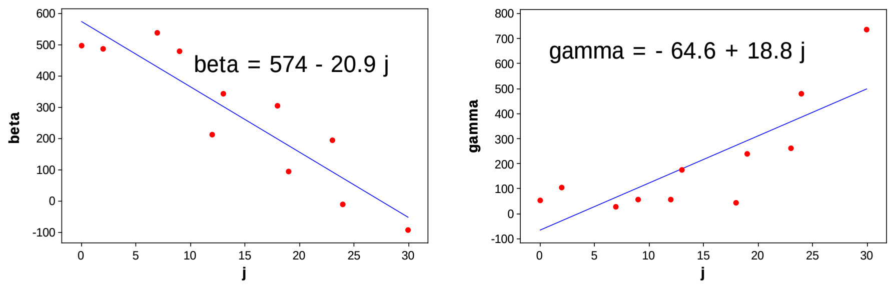
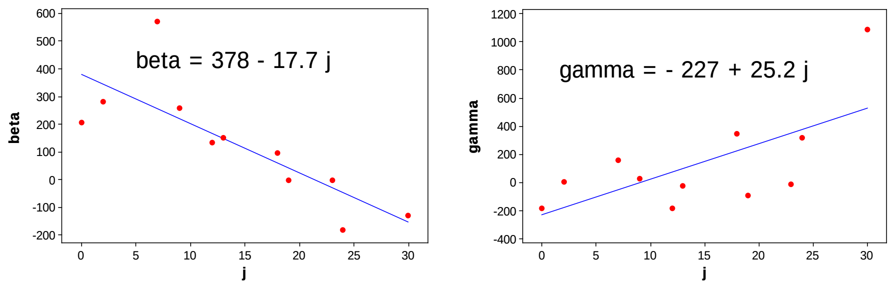


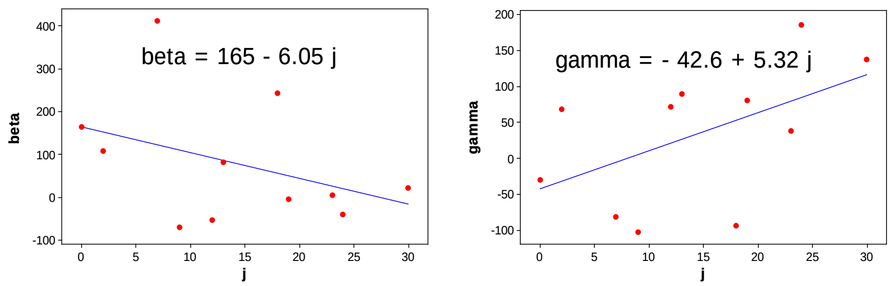
7.32 Jember



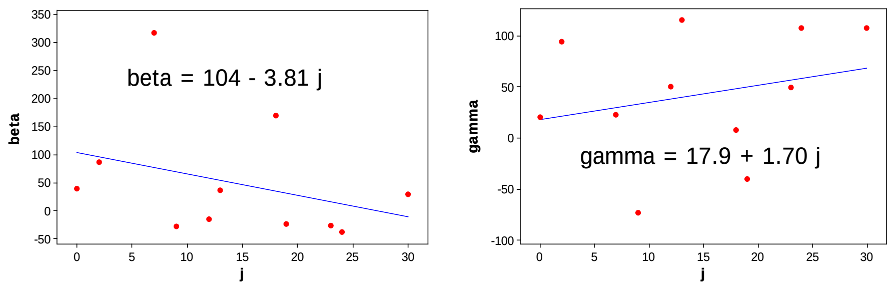
7.33 Bali



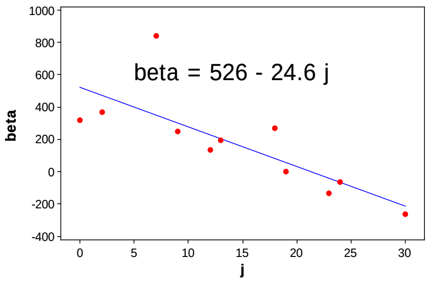
7.34 Nusa Tenggara Barat

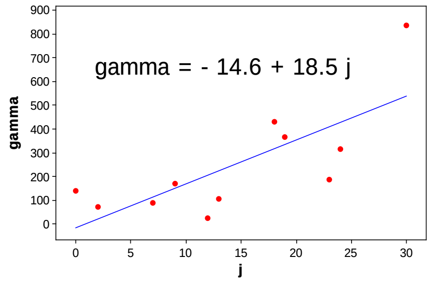


7.35 Nusa Tenggara Timur

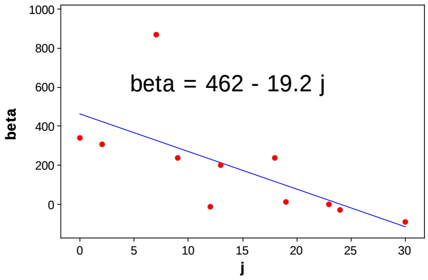


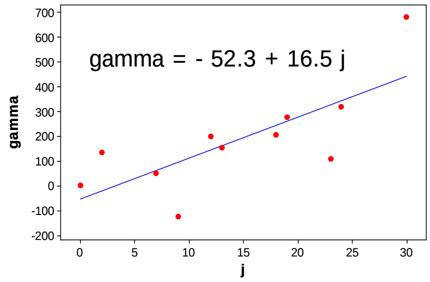
7.36 Kalimantan Selatan



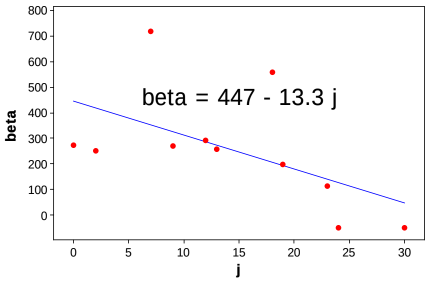


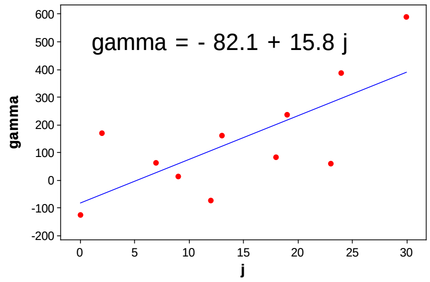
7.37 Kalimantan Barat



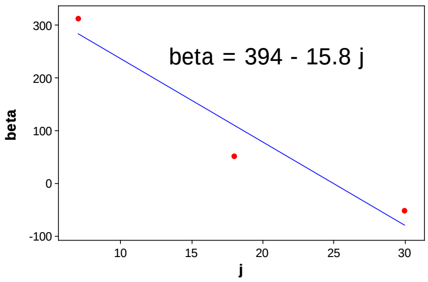


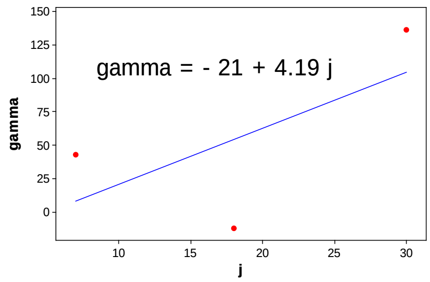
7.38 Kalimantan Timur



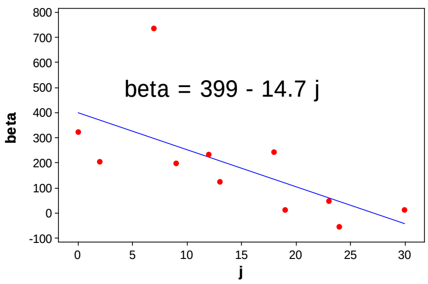


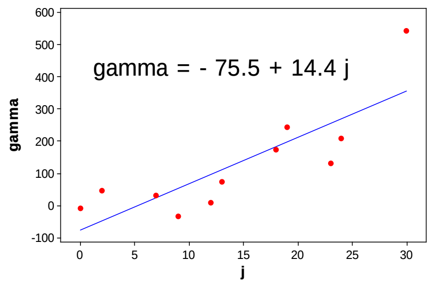
7.39 Kalimantan Tengah



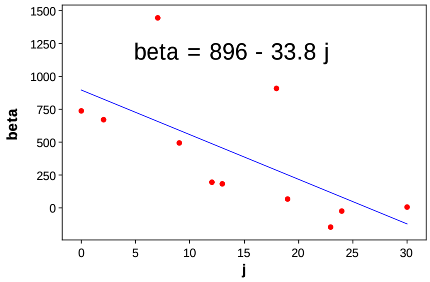


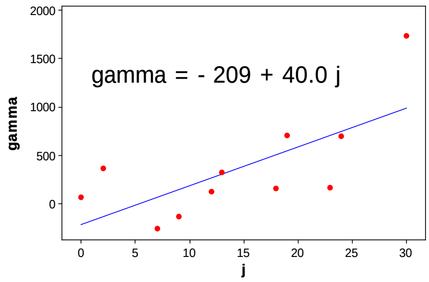
7.40 Balikpapan



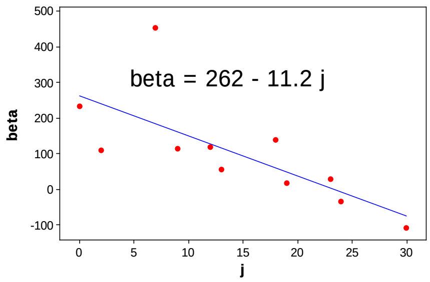


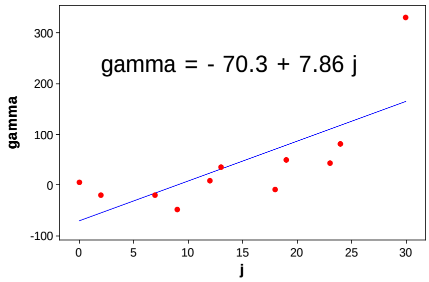
7.41 Sulawesi Selatan



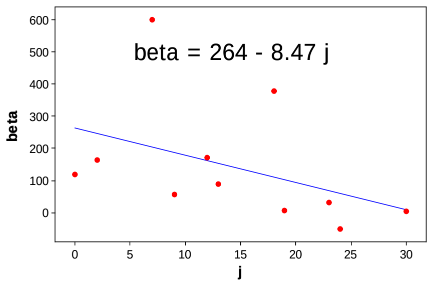


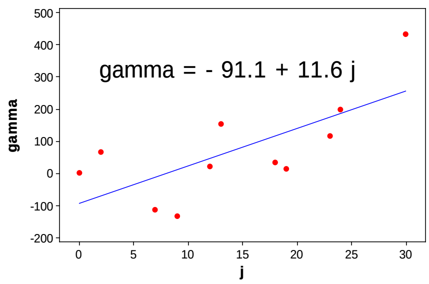
7.42 Sulawesi Tengah



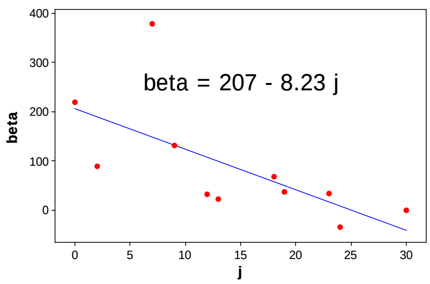


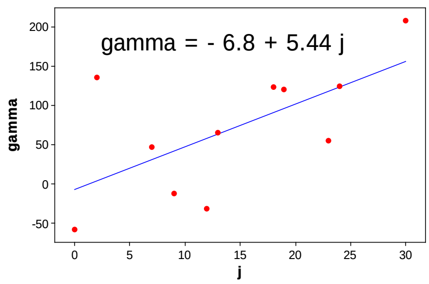
7.43 Sulawesi Utara





7.44 Sulawesi Tenggara





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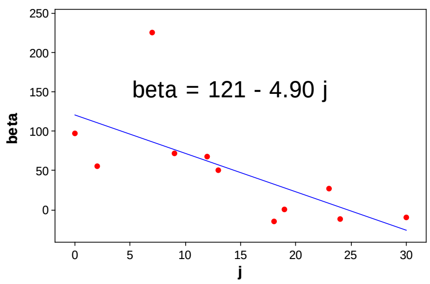

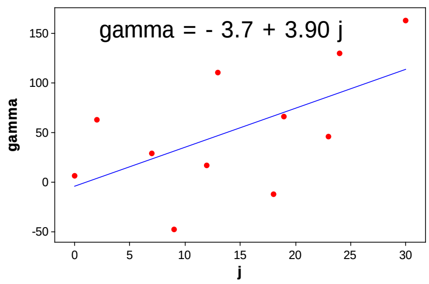

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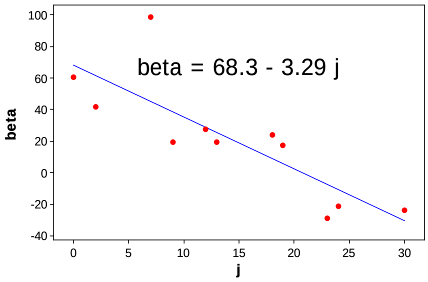
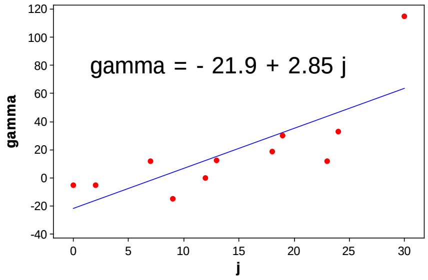
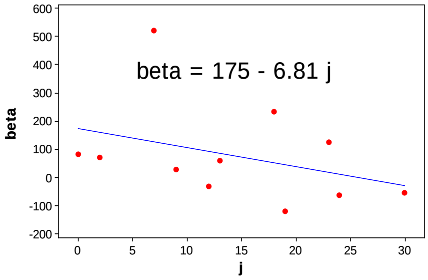
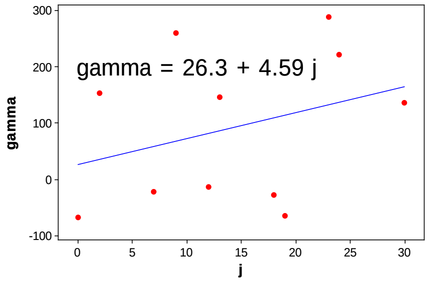




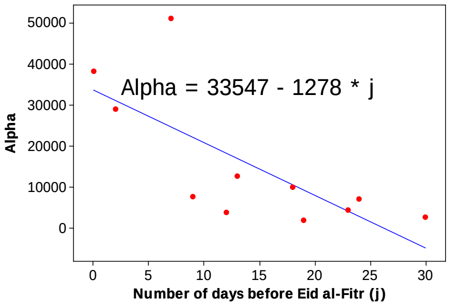
7.47 Papua

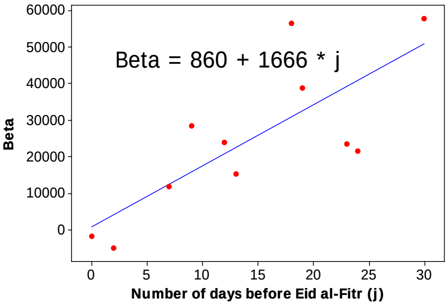




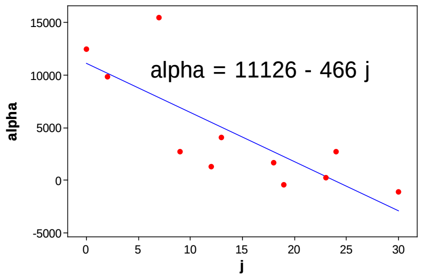
Appendix 8. Second Level ARIMAX Model for Currency Outflow

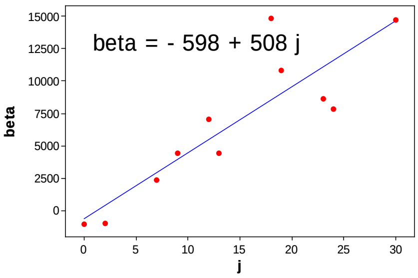
8.1 Indonesia



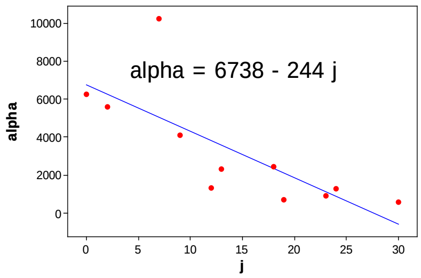


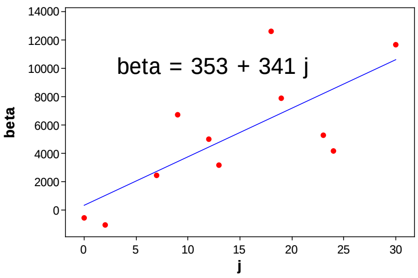
8.2 Jakarta



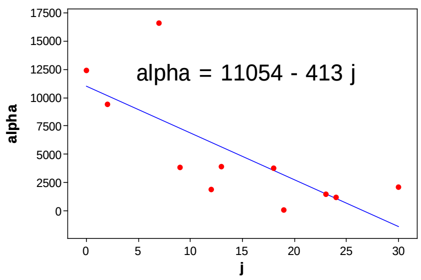


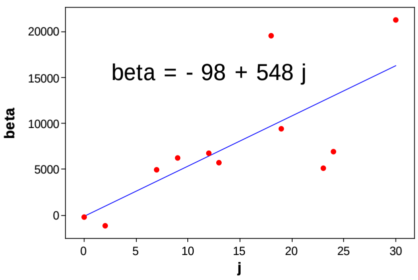
8.3 Sumatera





8.4 Jawa





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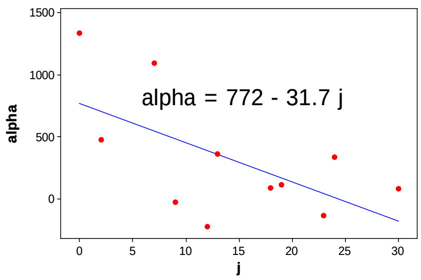
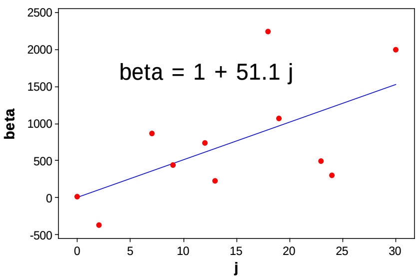
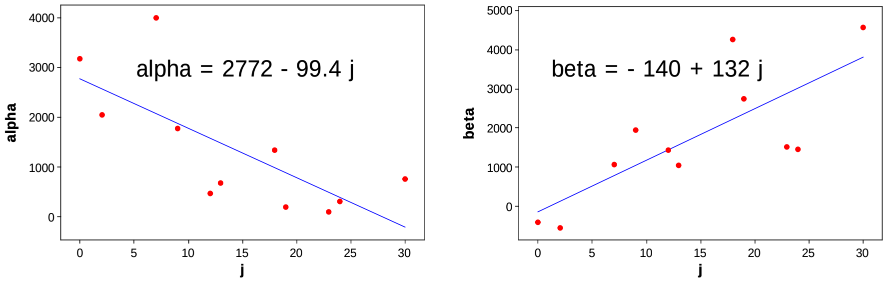
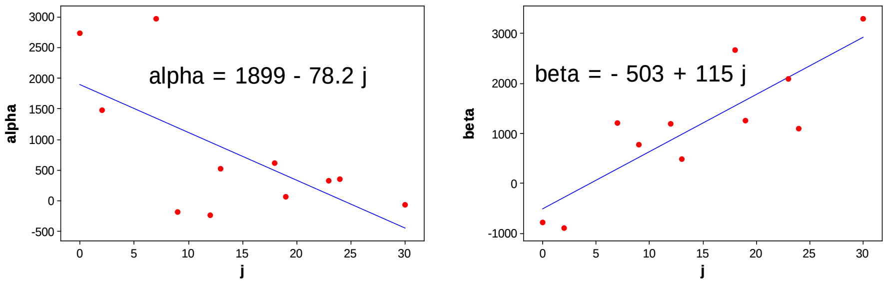




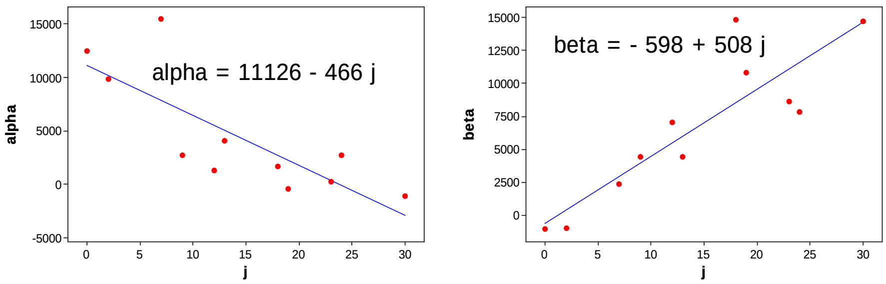
8.6 Kalimantan



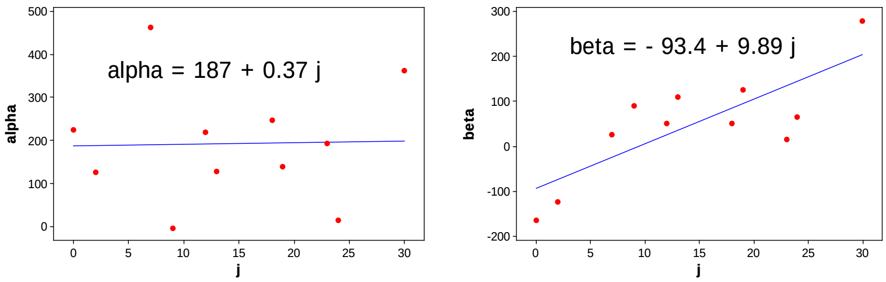
8.7 Sulampua



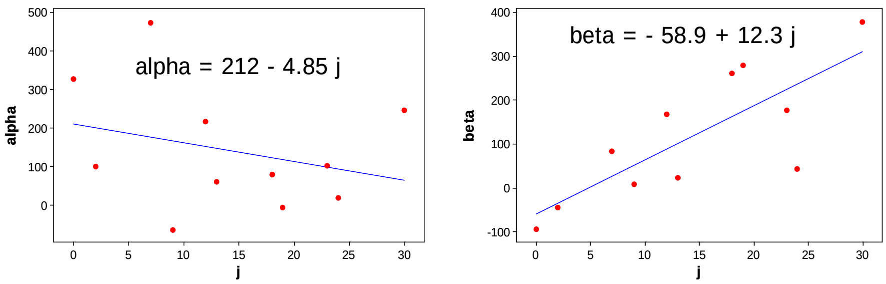
8.8 Jakarta



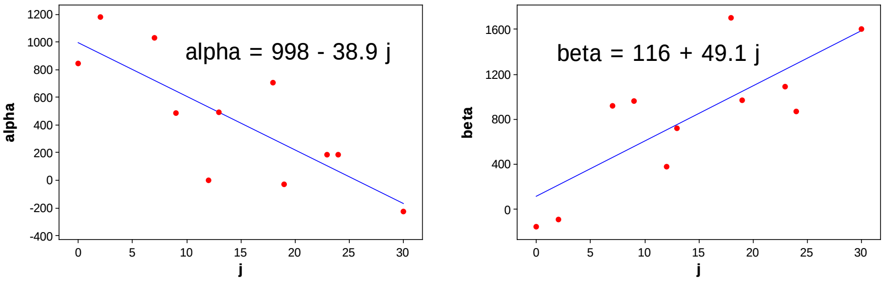
8.9 Aceh



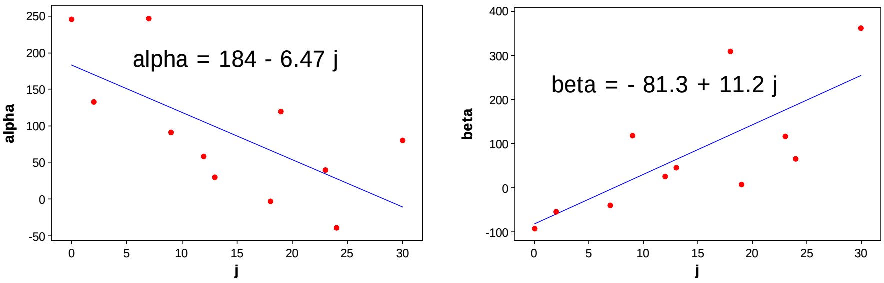
8.10 Lhokseumawe



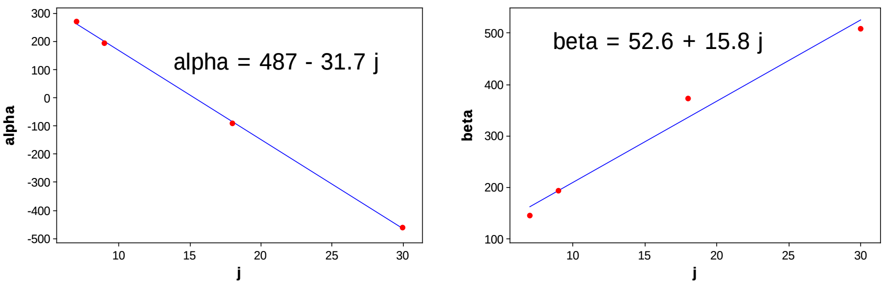
8.11 Sumatera Utara



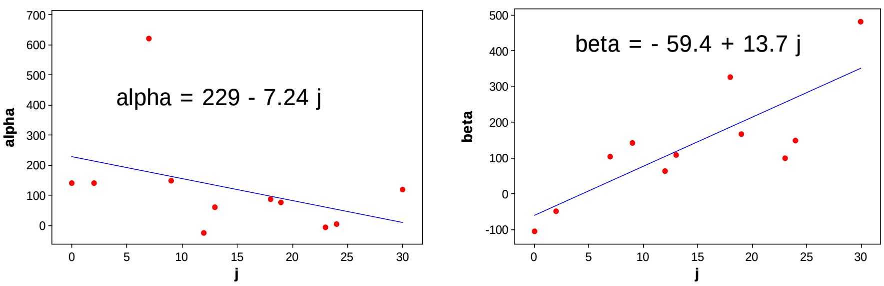
8.12 Sibolga



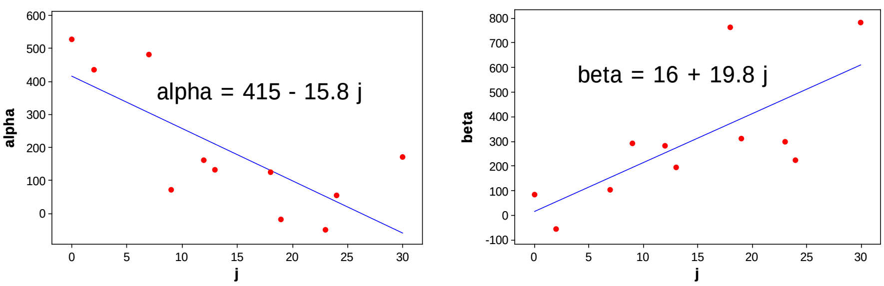
8.13 Pematang Siantar



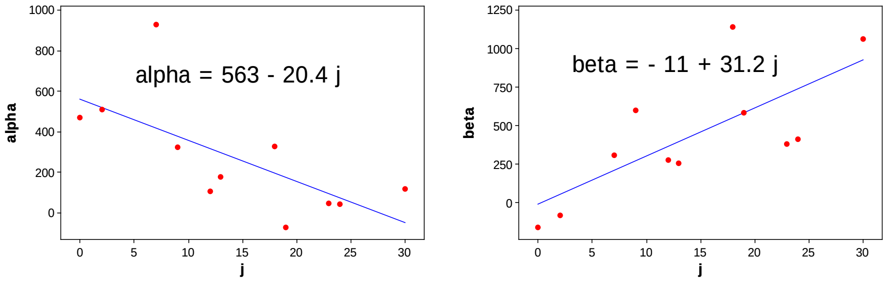
8.14 Bengkulu



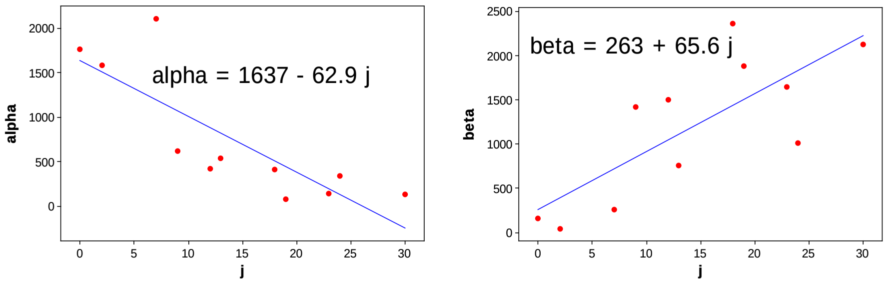
8.15 Jambi



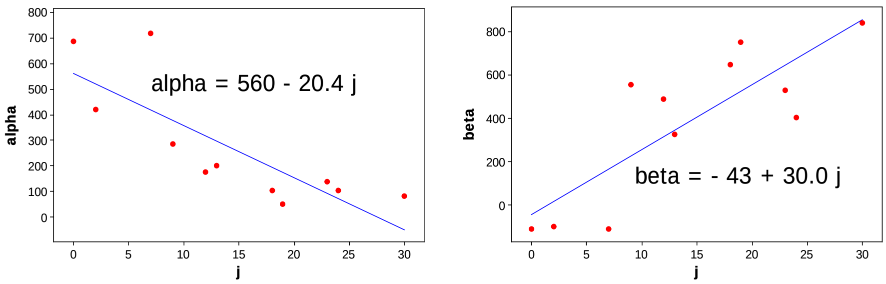
8.16 Sumatera Barat



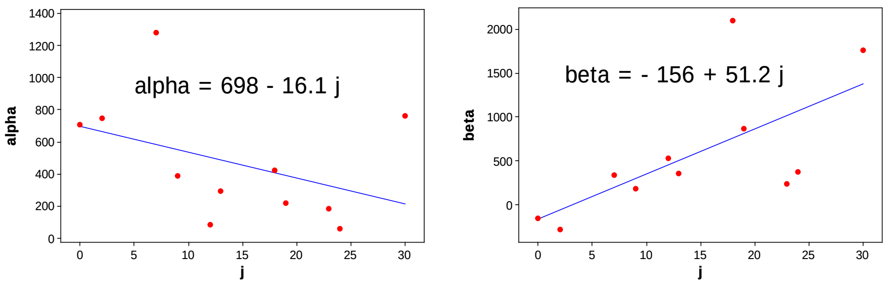
8.17 Riau



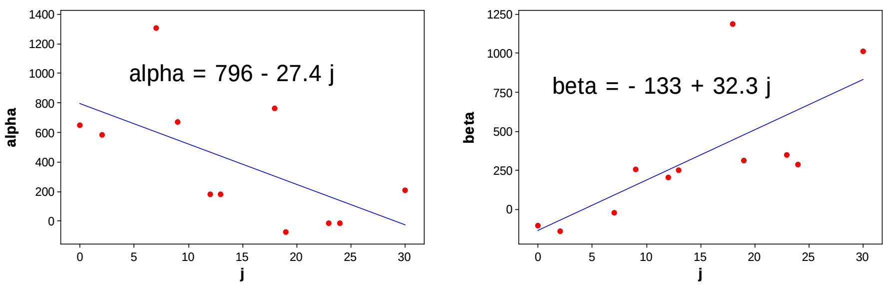
8.18 Kepulauan Riau



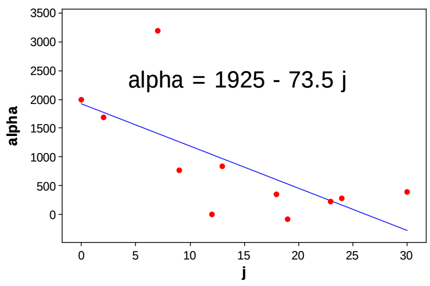
8.19 Sumatera Selatan

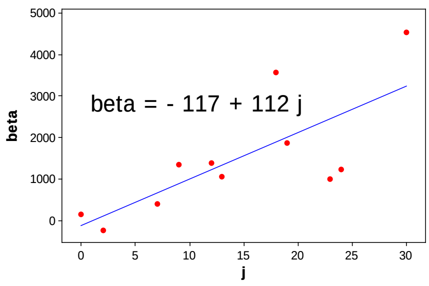


8.20 Lampung



8.21 Jawa Barat





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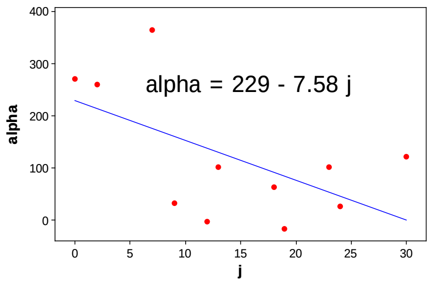
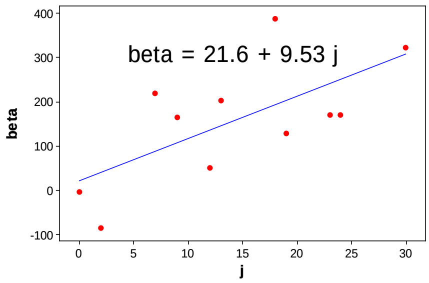
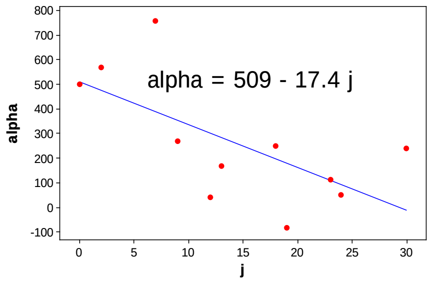
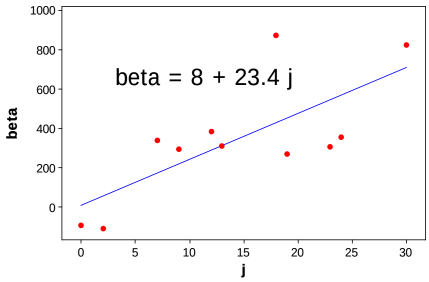


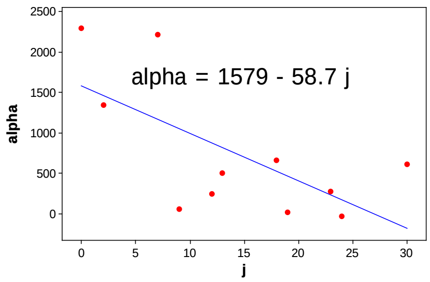


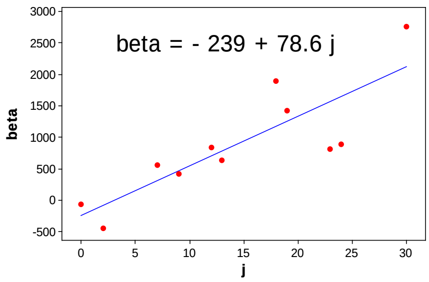
8.23 Cirebon



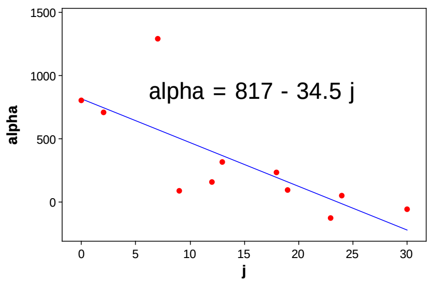


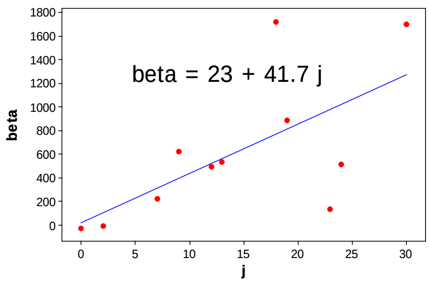
8.24 Jawa Tengah



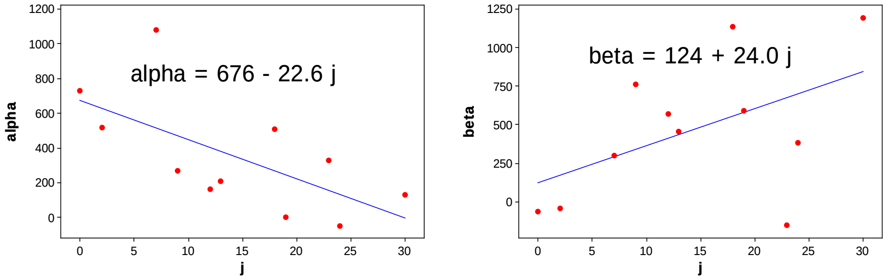


8.25 Yogyakarta

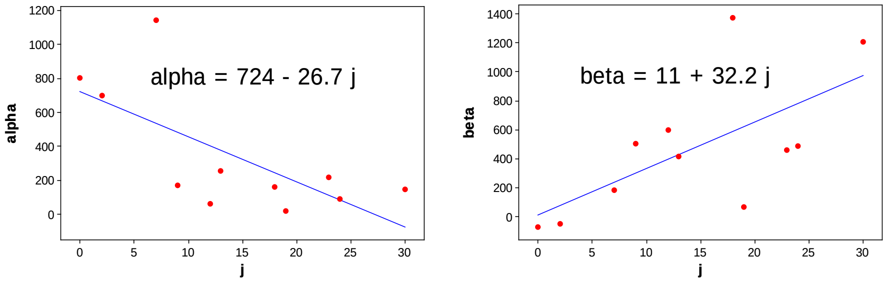




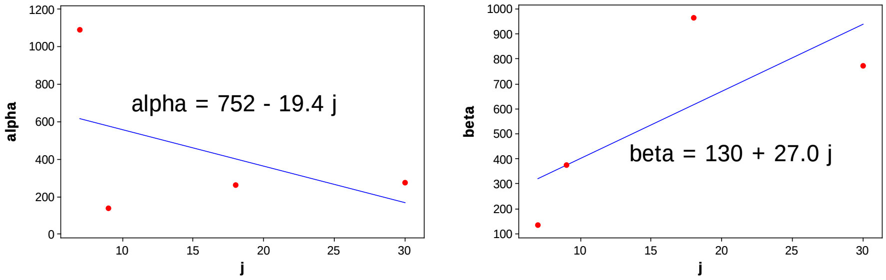
8.26 Solo



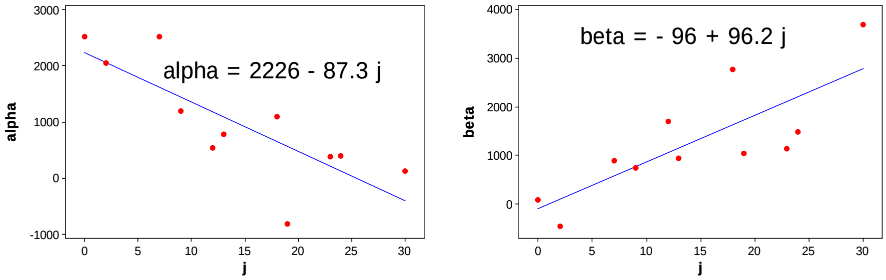
8.27 Purwokerto



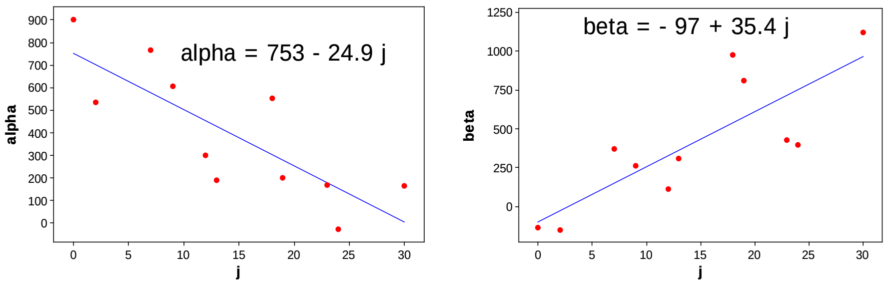
8.28 Tegal



8.29 Jawa Timur



8.30 Malang



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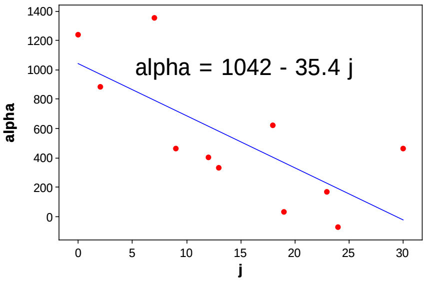
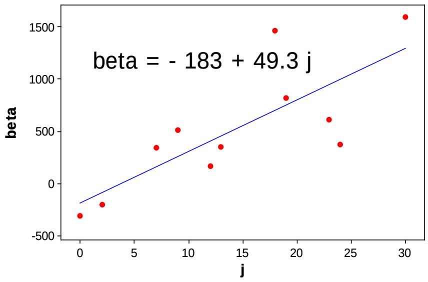
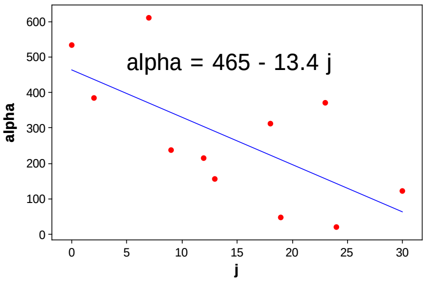
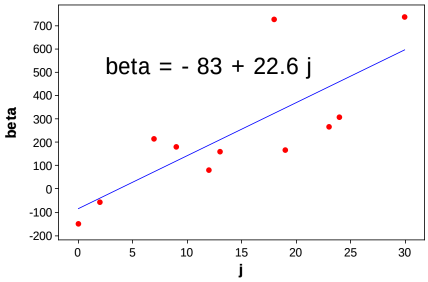


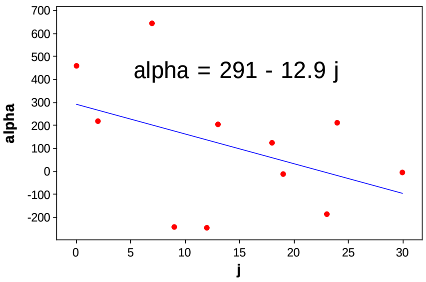


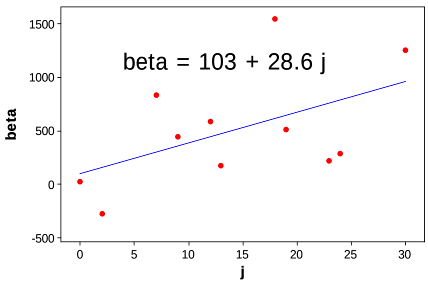
8.32 Jember



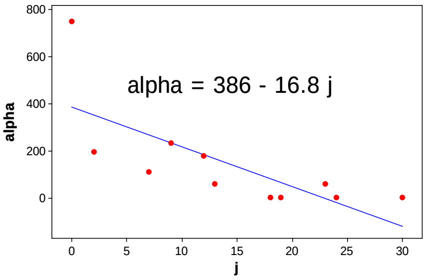


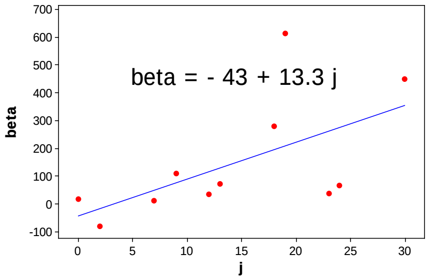
8.33 Bali



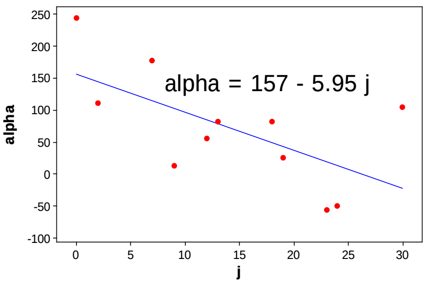


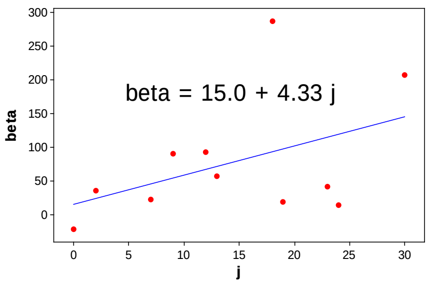
8.34 Nusa Tenggara Barat



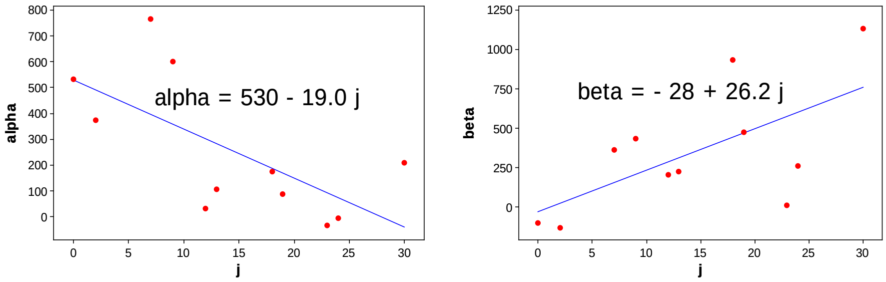


8.35 Nusa Tenggara Timur

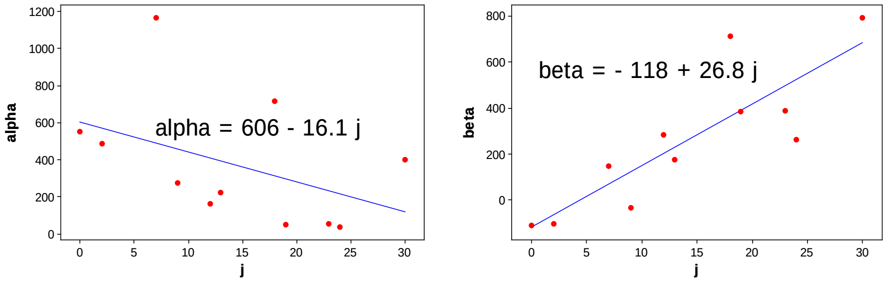




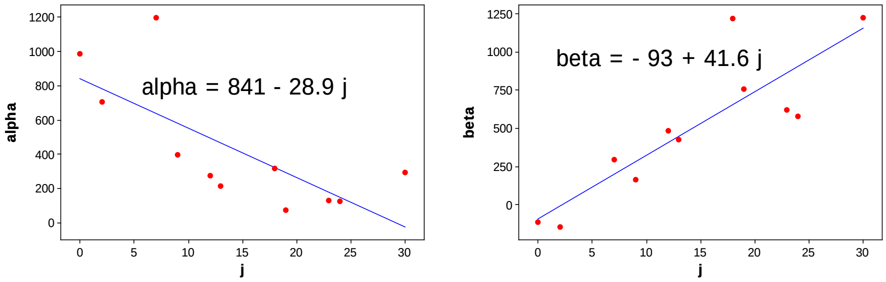
8.36 Kalimantan Selatan



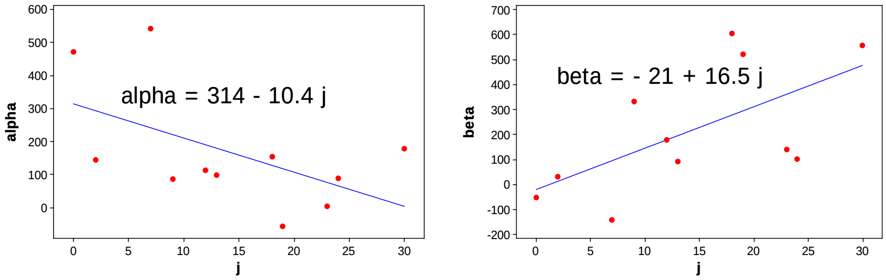
8.37 Kalimantan Barat



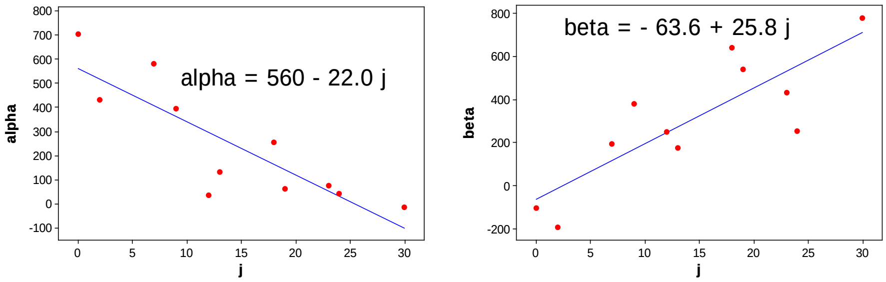
8.38 Kalimantan Timur



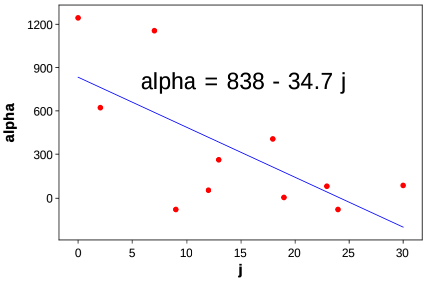
8.39 Kalimantan Tengah

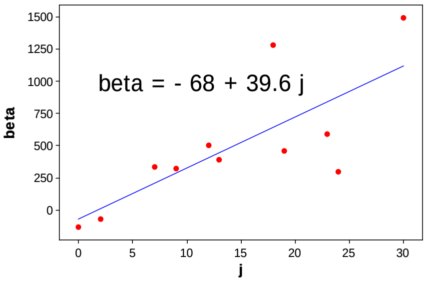


8.40 Balikpapan

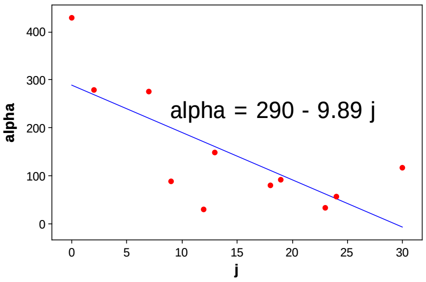


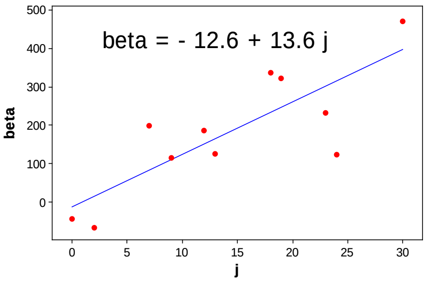
8.41 Sulawesi Selatan



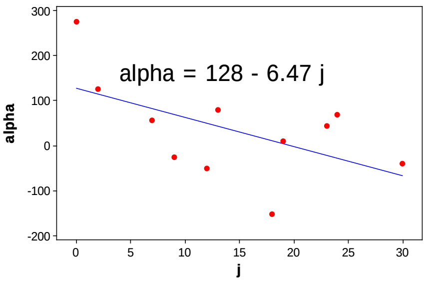


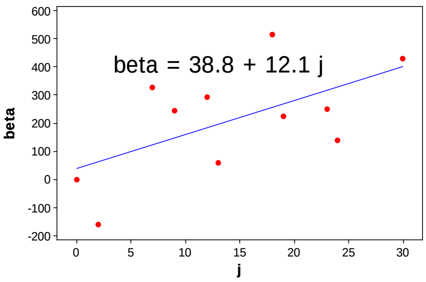
8.42 Sulawesi Tengah



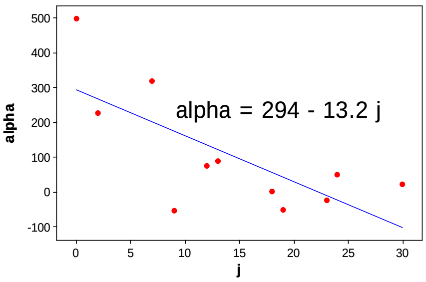


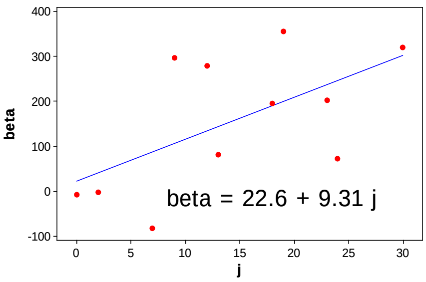
8.43 Sulawesi Utara



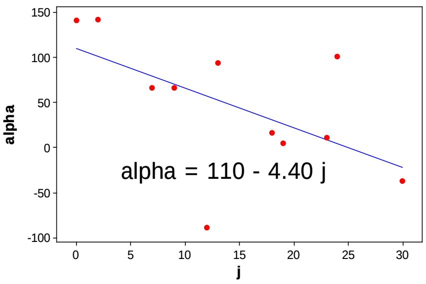


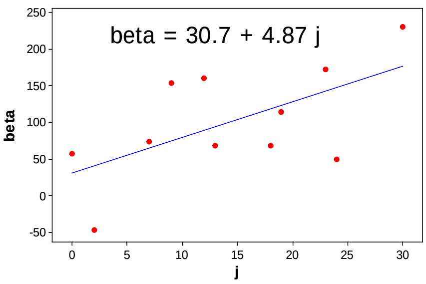
8.44 Sulawesi Tenggara



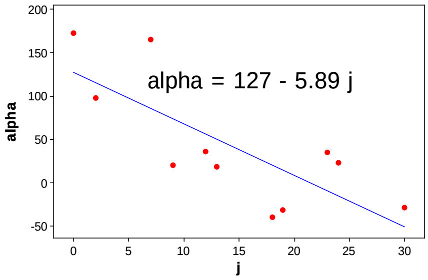


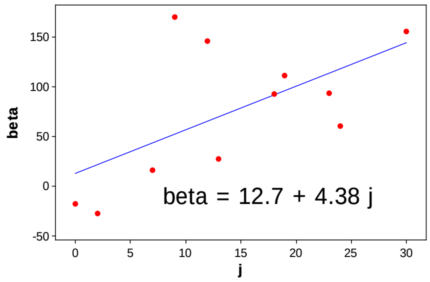
8.45 Maluku



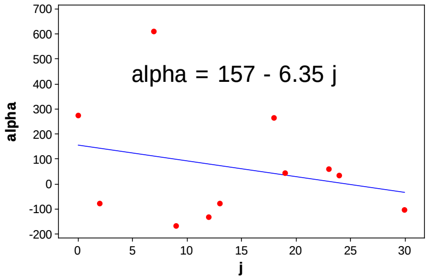


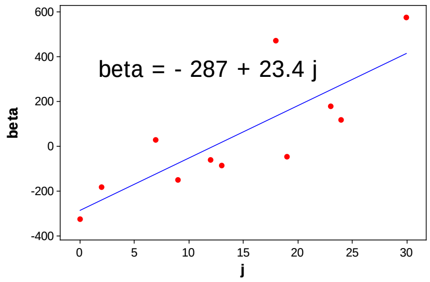
8.46 Maluku Utara





8.47 Papua

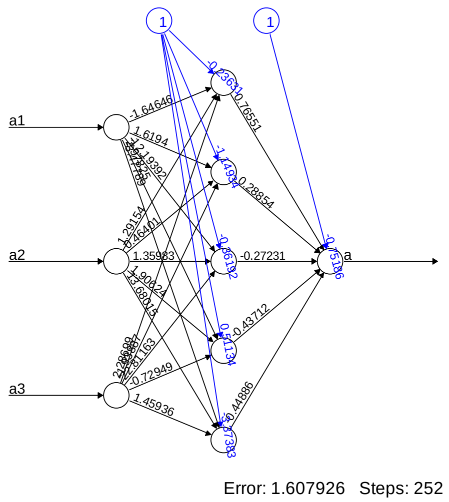


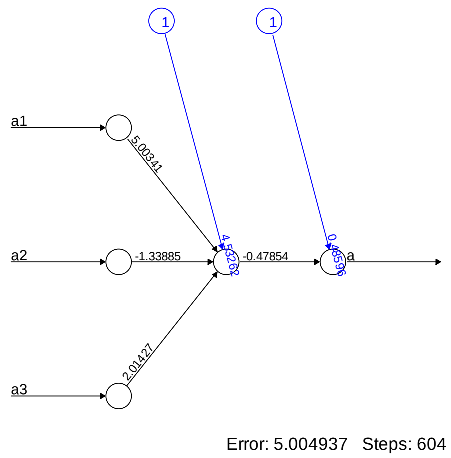


Appendix 9. Hybrid Model for Currency Inflow and Outflow Data

9.1 Indonesia

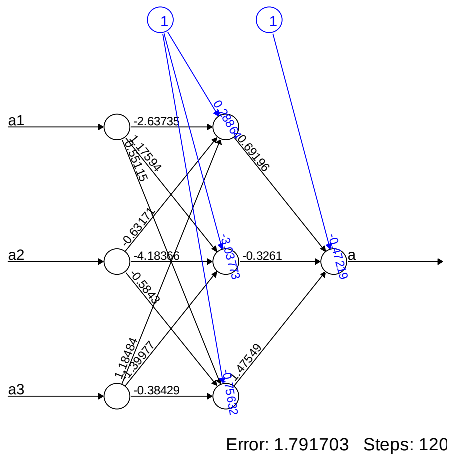
Model	RMSE on Inflow Data		RMSE on Outflow Data	
	In-sample	Out-of-sample	In-sample	Out-of-sample
ARIMAX	3449.8	15626.3	5575.0	12280.7
ARIMAX-ANN(3,1,1)	2719.5	15559.2	5173.8	**12182.7**
ARIMAX-ANN(3,2,1)	2609.9	15677.9	4922.4	12300.2
ARIMAX-ANN(3,3,1)	2517.8	15651.6	4652.3	12275.0
ARIMAX-ANN(3,4,1)	2395.5	15771.4	4424.0	12289.9
ARIMAX-ANN(3,5,1)	2330.9	**15530.3**	4151.5	12411.4

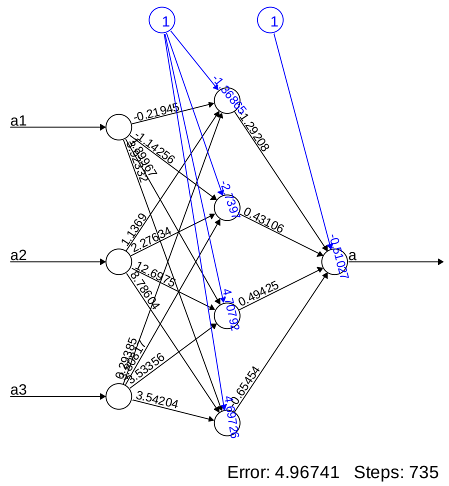




9.2 Jakarta

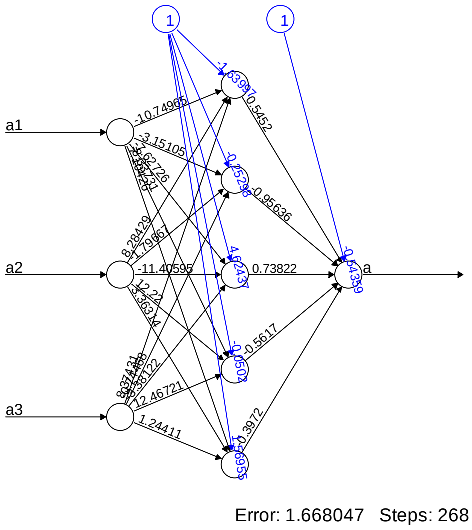
Model	RMSE on Inflow Data		RMSE on Outflow Data	
	In-sample	Out-of-sample	In-sample	Out-of-sample
ARIMAX	755.1	3815.1	1821.0	3203.8
ARIMAX-ANN(3,1,1)	588.7	3786.0	1702.8	3194.8
ARIMAX-ANN(3,2,1)	565.1	3762.0	1617.4	3180.0
ARIMAX-ANN(3,3,1)	550.2	**3730.4**	1483.5	3198.8
ARIMAX-ANN(3,4,1)	533.5	3754.9	1441.2	**3150.4**
ARIMAX-ANN(3,5,1)	533.2	3735.9	1358.0	3170.4

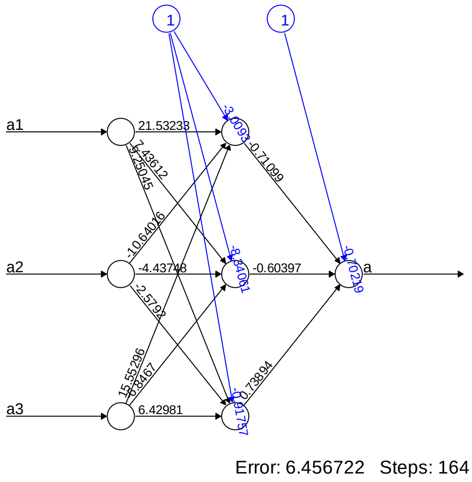




9.3 Sumatera

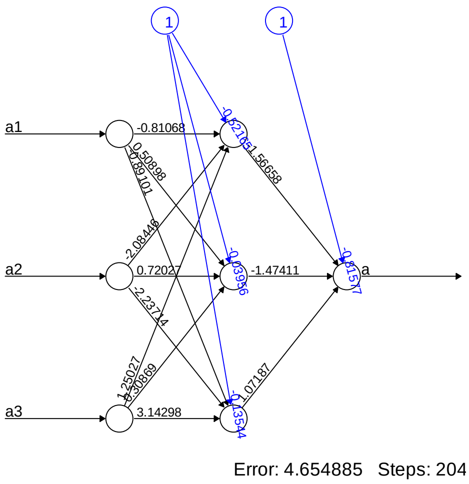
Model	RMSE on Inflow Data		RMSE on Outflow Data	
	In-sample	Out-of-sample	In-sample	Out-of-sample
ARIMAX	777.6	3267.5	1023.2	3306.9
ARIMAX-ANN(3,1,1)	673.9	3264.5	958.9	3314.5
ARIMAX-ANN(3,2,1)	624.3	3265.7	927.8	3383.4
ARIMAX-ANN(3,3,1)	568.7	3293.7	888.7	**3243.5**
ARIMAX-ANN(3,4,1)	572.4	3255.3	798.5	3472.0
ARIMAX-ANN(3,5,1)	525.3	**3221.9**	783.2	3316.3

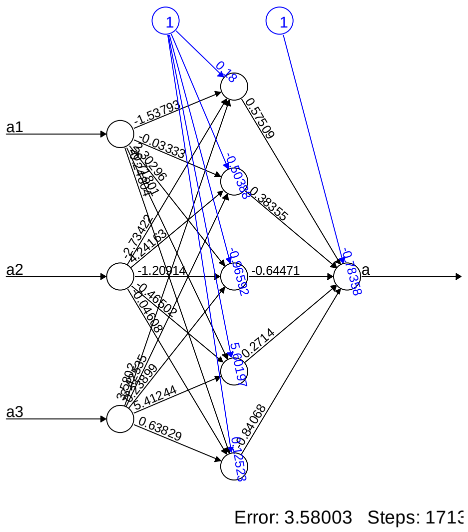




9.4 Jawa

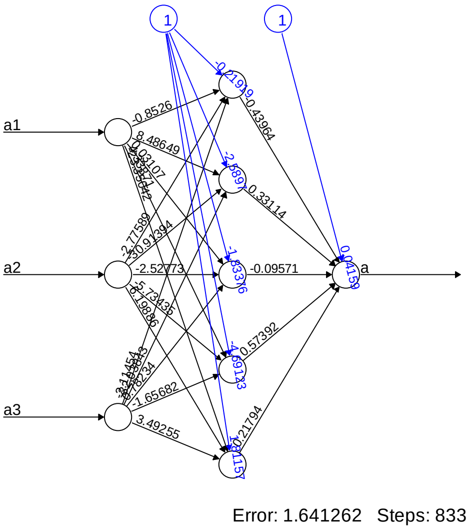
Model	RMSE on Inflow Data		RMSE on Outflow Data	
	In-sample	Out-of-sample	In-sample	Out-of-sample
ARIMAX	1480.3	5775.1	1647.9	4426.5
ARIMAX-ANN(3,1,1)	1272.4	5924.3	1574.4	4431.2
ARIMAX-ANN(3,2,1)	1198.8	5806.5	1481.7	5034.8
ARIMAX-ANN(3,3,1)	1129.2	**5675.9**	1439.2	4435.2
ARIMAX-ANN(3,4,1)	1052.9	5767.0	1405.5	4591.3
ARIMAX-ANN(3,5,1)	1023.5	5798.5	1369.8	**4424.5**

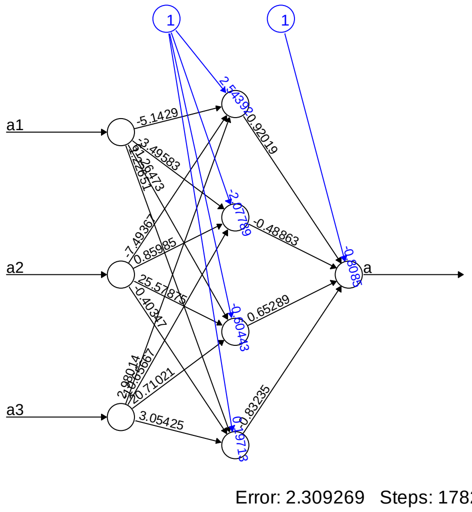




9.5 Balinusra

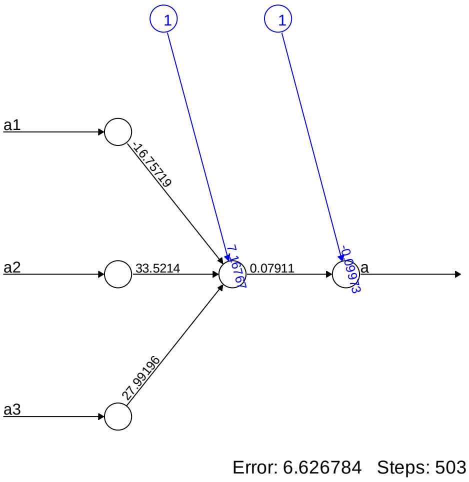
Model	RMSE on Inflow Data		RMSE on Outflow Data	
	In-sample	Out-of-sample	In-sample	Out-of-sample
ARIMAX	207.6	558.6	346.6	495.9
ARIMAX-ANN(3,1,1)	172.7	551.2	323.8	503.4
ARIMAX-ANN(3,2,1)	159.9	552.7	281.1	496.2
ARIMAX-ANN(3,3,1)	157.3	551.2	266.9	493.0
ARIMAX-ANN(3,4,1)	146.0	550.6	250.8	**468.2**
ARIMAX-ANN(3,5,1)	144.7	**549.5**	242.0	491.3

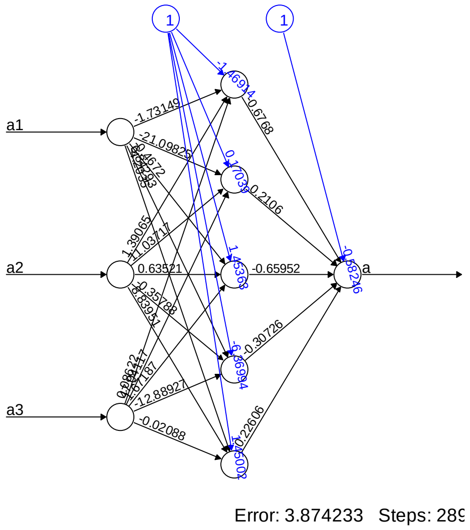




9.6 Kalimantan

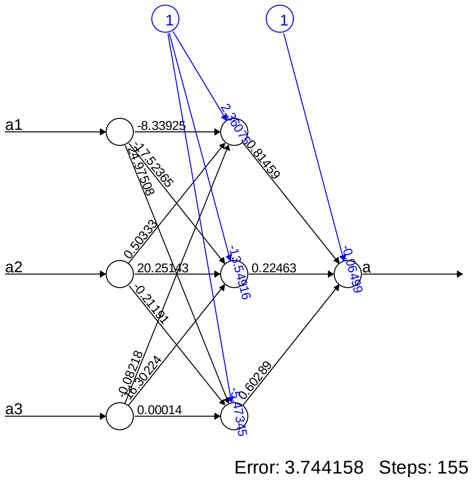
Model	RMSE on Inflow Data		RMSE on Outflow Data	
	In-sample	Out-of-sample	In-sample	Out-of-sample
ARIMAX	219.6	930.5	385.5	882.5
ARIMAX-ANN(3,1,1)	206.0	**903.1**	361.0	884.7
ARIMAX-ANN(3,2,1)	192.3	931.0	335.0	942.5
ARIMAX-ANN(3,3,1)	189.9	948.6	328.4	942.3
ARIMAX-ANN(3,4,1)	182.6	946.4	311.4	883.9
ARIMAX-ANN(3,5,1)	173.2	935.5	305.5	**878.7**

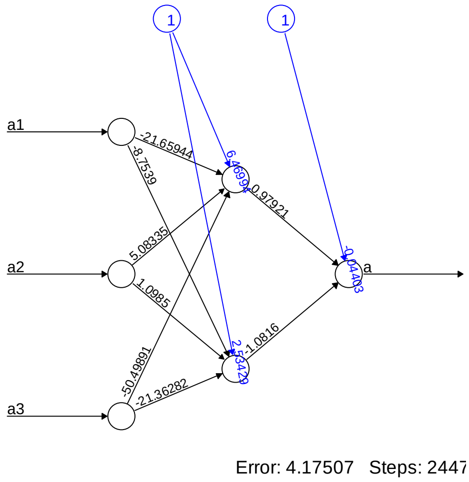




9.7 Sulampua

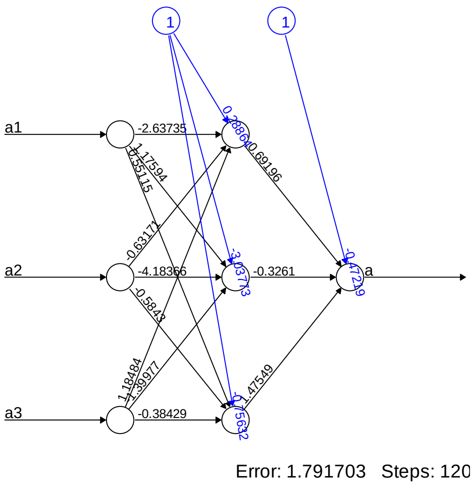
Model	RMSE on Inflow Data		RMSE on Outflow Data	
	In-sample	Out-of-sample	In-sample	Out-of-sample
ARIMAX	268.4	1270.7	588.6	874.8
ARIMAX-ANN(3,1,1)	246.3	1280.2	554.3	877.6
ARIMAX-ANN(3,2,1)	237.6	1259.5	516.3	**851.3**
ARIMAX-ANN(3,3,1)	219.0	**1222.6**	484.1	1050.8
ARIMAX-ANN(3,4,1)	210.0	1247.7	462.7	924.0
ARIMAX-ANN(3,5,1)	210.9	1230.8	450.7	890.6

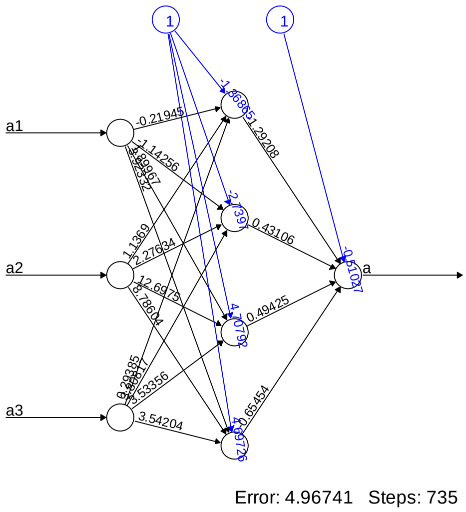




9.8 Jakarta

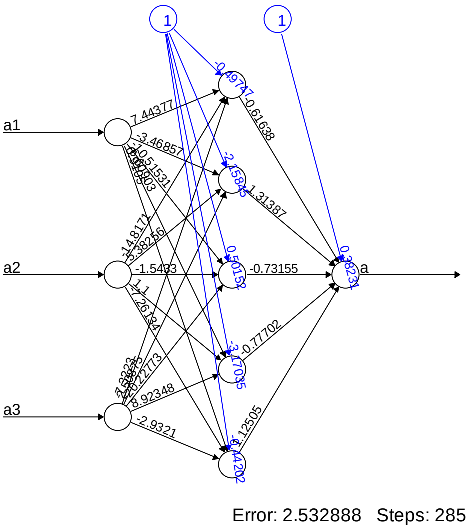
Model	RMSE on Inflow Data		RMSE on Outflow Data	
	In-sample	Out-of-sample	In-sample	Out-of-sample
ARIMAX	755.1	3815.1	1821.0	3203.8
ARIMAX-ANN(3,1,1)	588.7	3786.0	1702.8	3194.8
ARIMAX-ANN(3,2,1)	565.1	3762.0	1617.4	3180.0
ARIMAX-ANN(3,3,1)	550.2	**3730.4**	1483.5	3198.8
ARIMAX-ANN(3,4,1)	533.5	3754.9	1441.2	**3150.4**
ARIMAX-ANN(3,5,1)	533.2	3735.9	1358.0	3170.4





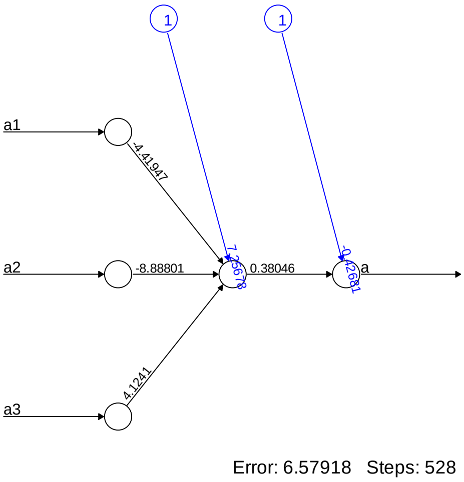
9.9 Aceh

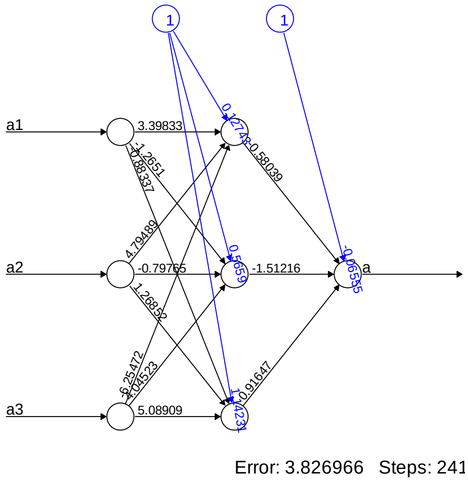
Model	RMSE on Inflow Data		RMSE on Outflow Data	
	In-sample	Out-of-sample	In-sample	Out-of-sample
ARIMAX	37.6	162.0	105.8	**278.7**
ARIMAX-ANN(3,1,1)	31.9	166.5	99.1	287.8
ARIMAX-ANN(3,2,1)	30.2	163.3	90.5	312.8
ARIMAX-ANN(3,3,1)	28.5	163.6	83.7	325.5
ARIMAX-ANN(3,4,1)	27.9	165.3	75.1	318.7
ARIMAX-ANN(3,5,1)	26.5	**156.8**	74.3	321.2



9.10 Lhokseumawe

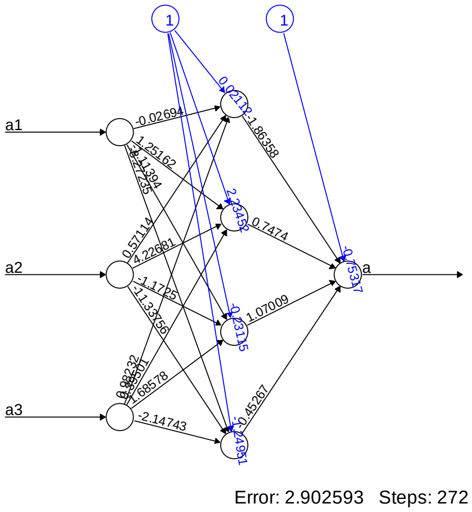
Model	RMSE on Inflow Data		RMSE on Outflow Data	
	In-sample	Out-of-sample	In-sample	Out-of-sample
ARIMAX	24.4	128.5	70.9	104.9
ARIMAX-ANN(3,1,1)	22.4	**127.9**	67.8	105.2
ARIMAX-ANN(3,2,1)	21.0	130.7	61.4	104.7
ARIMAX-ANN(3,3,1)	19.6	133.4	57.6	**94.6**
ARIMAX-ANN(3,4,1)	18.7	129.1	53.4	104.6
ARIMAX-ANN(3,5,1)	17.8	128.7	49.4	107.5

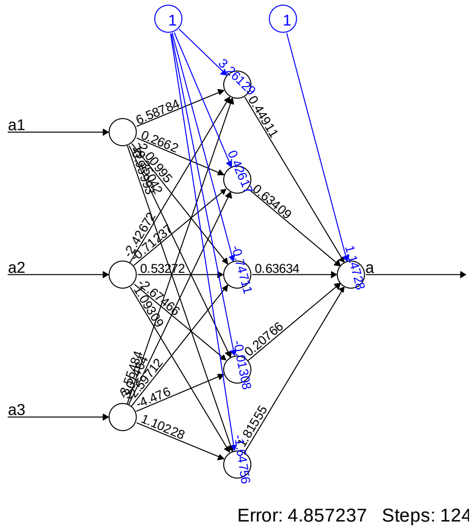




9.11 Sumatera Utara

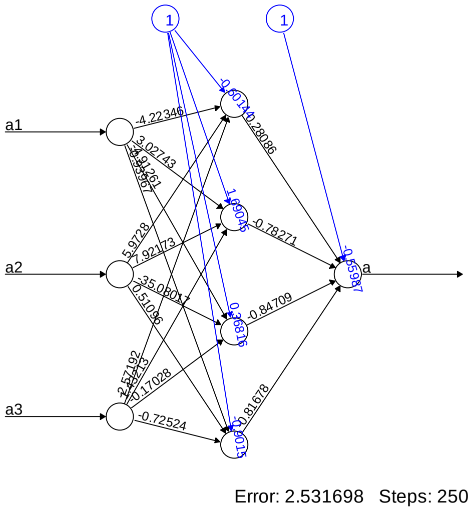
Model	RMSE on Inflow Data		RMSE on Outflow Data	
	In-sample	Out-of-sample	In-sample	Out-of-sample
ARIMAX	279.2	700.5	209.4	568.0
ARIMAX-ANN(3,1,1)	242.6	691.8	196.5	565.1
ARIMAX-ANN(3,2,1)	234.7	701.7	189.2	585.8
ARIMAX-ANN(3,3,1)	222.3	692.2	184.5	561.9
ARIMAX-ANN(3,4,1)	203.8	**675.0**	179.4	603.0
ARIMAX-ANN(3,5,1)	198.5	687.6	174.9	**553.5**

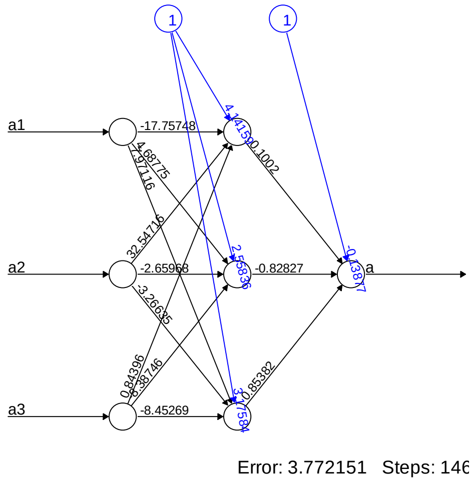




9.12 Sibolga

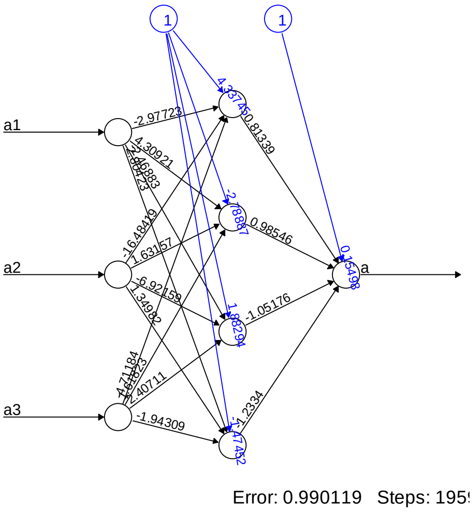
Model	RMSE on Inflow Data		RMSE on Outflow Data	
	In-sample	Out-of-sample	In-sample	Out-of-sample
ARIMAX	13.9	129.2	61.6	151.9
ARIMAX-ANN(3,1,1)	12.0	128.6	57.9	149.9
ARIMAX-ANN(3,2,1)	11.0	129.0	52.8	165.8
ARIMAX-ANN(3,3,1)	10.7	128.9	50.7	**143.1**
ARIMAX-ANN(3,4,1)	10.2	**127.5**	46.6	173.0
ARIMAX-ANN(3,5,1)	9.9	128.9	45.2	162.5

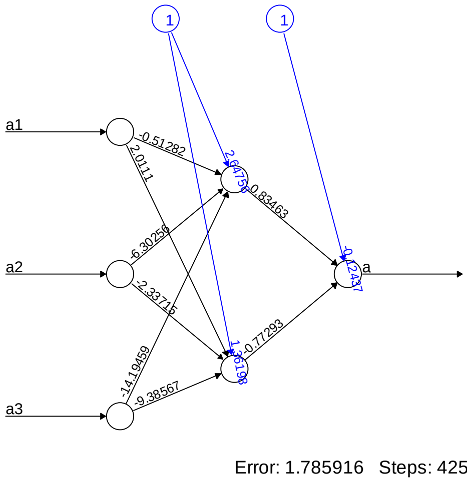




9.13 Pematang Siantar

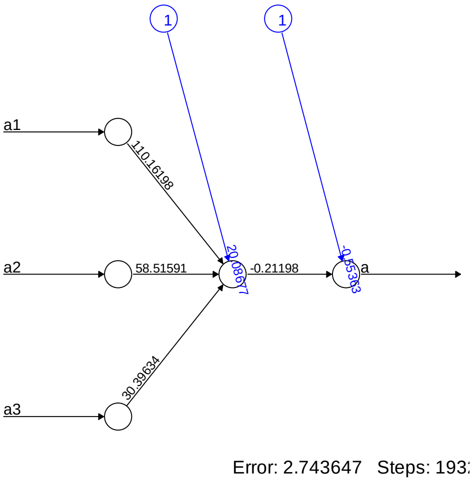
Model	RMSE on Inflow Data		RMSE on Outflow Data	
	In-sample	Out-of-sample	In-sample	Out-of-sample
ARIMAX	39.0	177.5	151.0	500.5
ARIMAX-ANN(3,1,1)	36.3	176.9	136.8	458.4
ARIMAX-ANN(3,2,1)	30.6	171.6	123.2	**450.9**
ARIMAX-ANN(3,3,1)	25.2	176.7	110.2	497.3
ARIMAX-ANN(3,4,1)	21.2	**169.1**	101.0	495.7
ARIMAX-ANN(3,5,1)	18.0	174.8	95.3	461.7

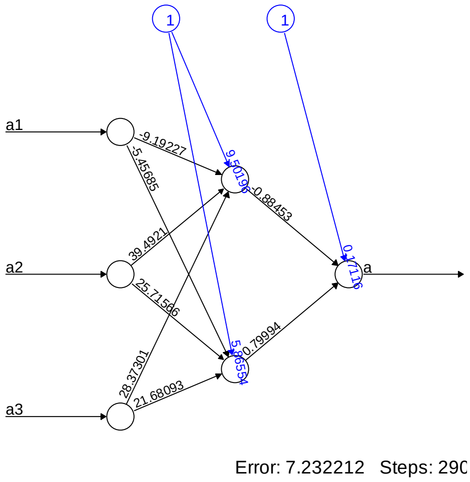




9.14 Bengkulu

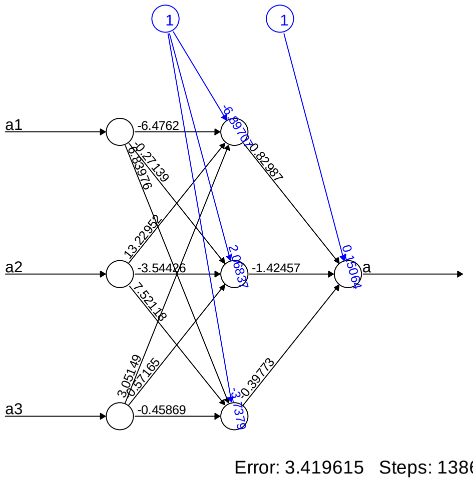
Model	RMSE on Inflow Data		RMSE on Outflow Data	
	In-sample	Out-of-sample	In-sample	Out-of-sample
ARIMAX	25.5	**203.0**	48.7	145.2
ARIMAX-ANN(3,1,1)	21.1	201.2	47.0	145.5
ARIMAX-ANN(3,2,1)	19.7	201.5	43.7	**144.7**
ARIMAX-ANN(3,3,1)	19.5	201.6	42.6	147.1
ARIMAX-ANN(3,4,1)	18.7	202.6	41.6	149.4
ARIMAX-ANN(3,5,1)	18.2	202.1	38.4	149.5

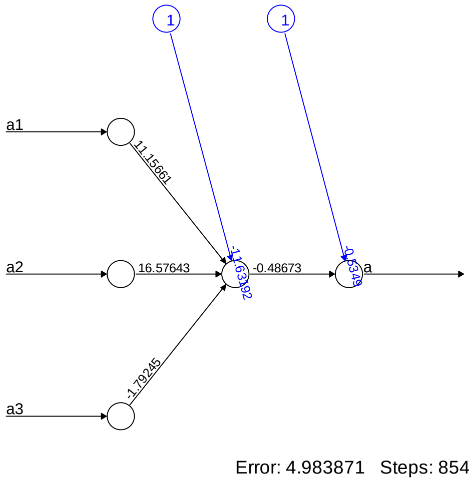




9.15 Jambi

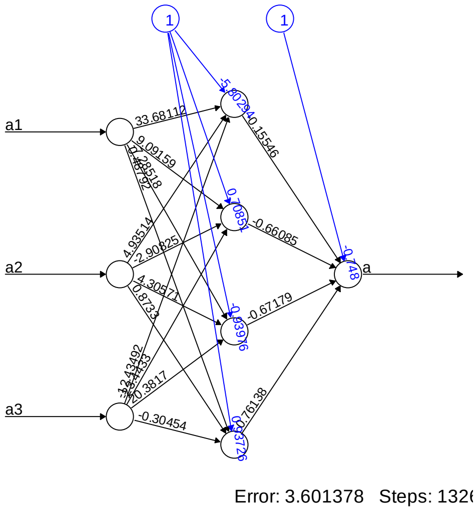
Model	RMSE on Inflow Data		RMSE on Outflow Data	
	In-sample	Out-of-sample	In-sample	Out-of-sample
ARIMAX	24.8	253.8	89.4	388.3
ARIMAX-ANN(3,1,1)	21.5	253.3	85.2	**387.1**
ARIMAX-ANN(3,2,1)	19.8	258.6	79.9	407.9
ARIMAX-ANN(3,3,1)	18.4	**252.9**	77.9	407.5
ARIMAX-ANN(3,4,1)	17.5	254.6	73.6	434.6
ARIMAX-ANN(3,5,1)	16.0	254.2	70.4	398.0

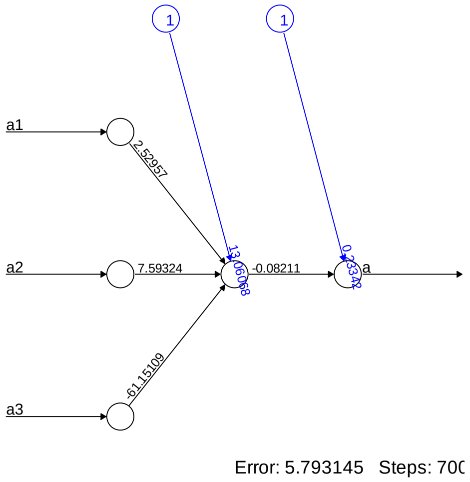




9.16 Sumatera Barat

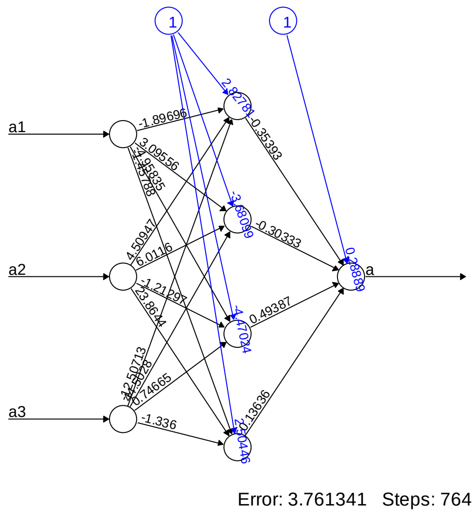
Model	RMSE on Inflow Data		RMSE on Outflow Data	
	In-sample	Out-of-sample	In-sample	Out-of-sample
ARIMAX	181.1	368.6	117.0	271.5
ARIMAX-ANN(3,1,1)	162.5	355.1	113.0	**268.1**
ARIMAX-ANN(3,2,1)	149.0	372.6	108.9	290.6
ARIMAX-ANN(3,3,1)	144.7	395.8	101.5	277.1
ARIMAX-ANN(3,4,1)	137.6	**347.4**	98.2	280.2
ARIMAX-ANN(3,5,1)	128.0	363.6	95.8	291.1





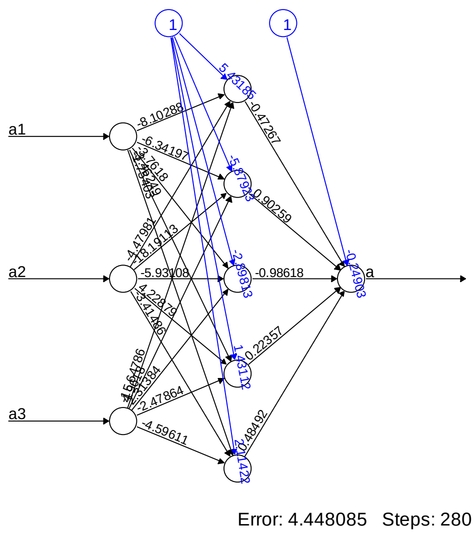
9.17 Riau

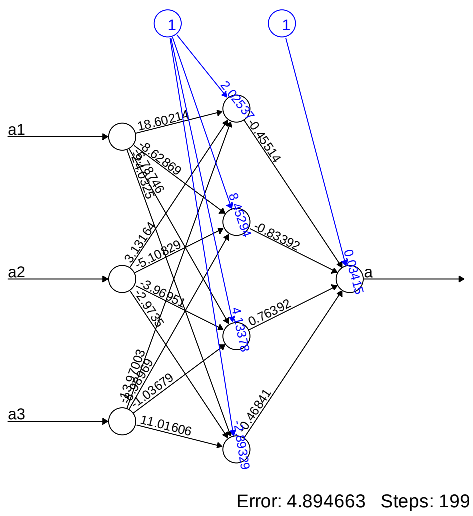
Model	RMSE on Inflow Data		RMSE on Outflow Data	
	In-sample	Out-of-sample	In-sample	Out-of-sample
ARIMAX	40.2	397.4	268.4	**503.1**
ARIMAX-ANN(3,1,1)	36.6	400.5	265.6	507.7
ARIMAX-ANN(3,2,1)	35.0	400.1	226.2	517.6
ARIMAX-ANN(3,3,1)	31.8	402.2	211.9	587.1
ARIMAX-ANN(3,4,1)	30.5	**393.6**	207.8	563.2
ARIMAX-ANN(3,5,1)	28.5	398.8	204.0	533.5



9.18 Kepulauan Riau

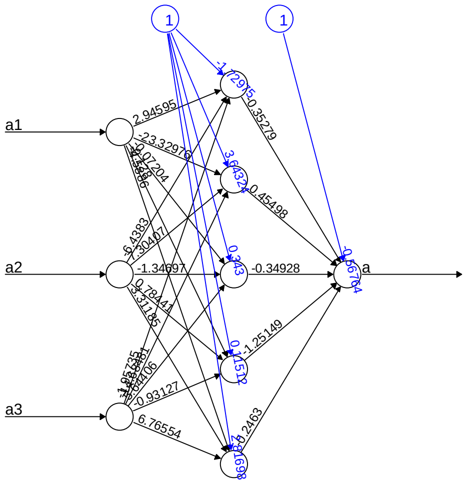
Model	RMSE on Inflow Data		RMSE on Outflow Data	
	In-sample	Out-of-sample	In-sample	Out-of-sample
ARIMAX	32.5	118.3	108.5	323.8
ARIMAX-ANN(3,1,1)	30.3	117.8	102.9	325.7
ARIMAX-ANN(3,2,1)	27.1	119.3	97.5	315.3
ARIMAX-ANN(3,3,1)	26.0	118.3	89.4	326.6
ARIMAX-ANN(3,4,1)	24.6	118.6	88.6	**313.8**
ARIMAX-ANN(3,5,1)	24.4	**117.6**	83.3	328.9





9.19 Sumatera Selatan

Model	RMSE on Inflow Data		RMSE on Outflow Data	
	In-sample	Out-of-sample	In-sample	Out-of-sample
ARIMAX	98.3	479.6	275.8	**540.3**
ARIMAX-ANN(3,1,1)	80.4	474.8	259.5	562.0
ARIMAX-ANN(3,2,1)	76.3	473.4	248.0	565.7
ARIMAX-ANN(3,3,1)	70.8	473.7	229.4	597.7
ARIMAX-ANN(3,4,1)	66.4	476.9	202.6	583.7
ARIMAX-ANN(3,5,1)	65.0	**473.0**	180.5	638.9



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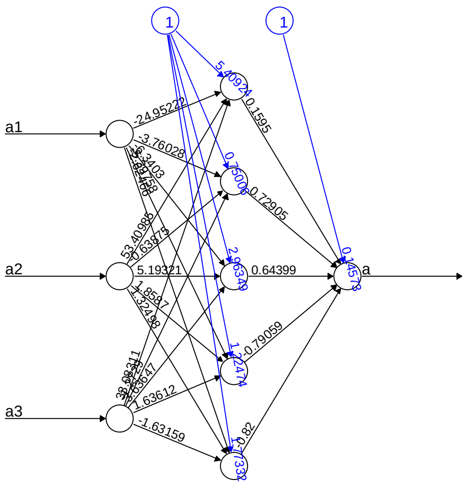
9.20 Lampung

Model	RMSE on Inflow Data		RMSE on Outflow Data	
	In-sample	Out-of-sample	In-sample	Out-of-sample
ARIMAX	131.0	403.5	154.3	**366.6**
ARIMAX-ANN(3,1,1)	116.4	396.9	144.9	370.5
ARIMAX-ANN(3,2,1)	111.4	396.2	128.3	367.7
ARIMAX-ANN(3,3,1)	105.3	402.0	124.9	368.5
ARIMAX-ANN(3,4,1)	100.0	387.3	122.3	375.0
ARIMAX-ANN(3,5,1)	93.3	**386.0**	119.2	374.6



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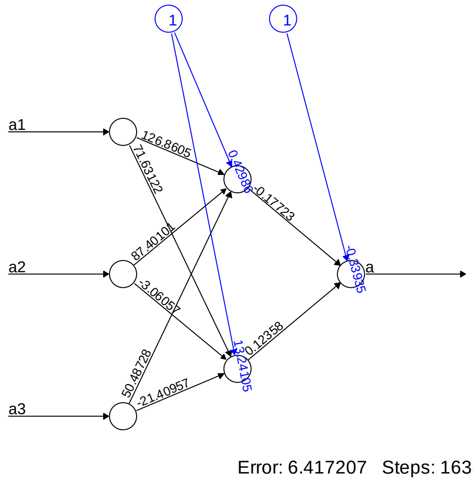
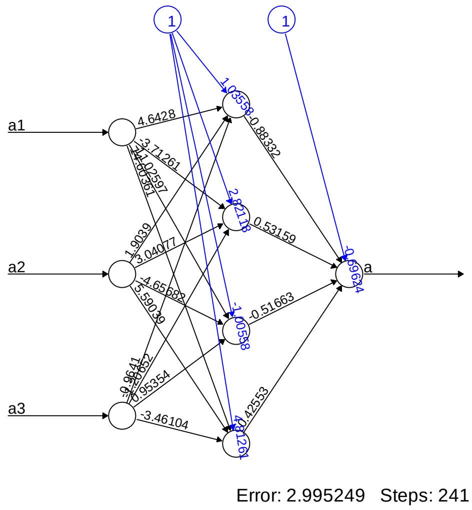
9.21 Jawa Barat

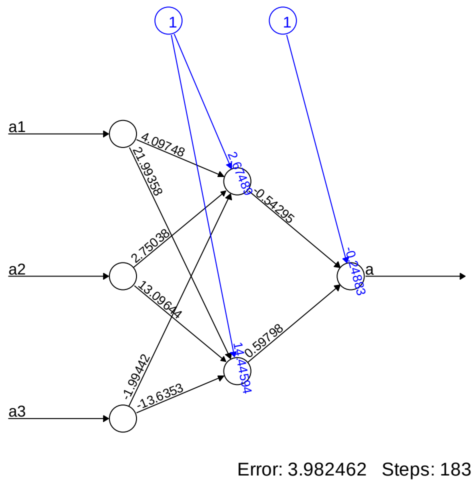
Model	RMSE on Inflow Data		RMSE on Outflow Data	
	In-sample	Out-of-sample	In-sample	Out-of-sample
ARIMAX	302.7	1166.2	322.8	931.4
ARIMAX-ANN(3,1,1)	271.5	1180.7	304.4	930.7
ARIMAX-ANN(3,2,1)	257.3	**1117.0**	290.6	932.2
ARIMAX-ANN(3,3,1)	244.9	1123.4	276.1	928.0
ARIMAX-ANN(3,4,1)	236.4	1165.7	265.7	**911.4**
ARIMAX-ANN(3,5,1)	226.1	1120.6	265.4	922.9

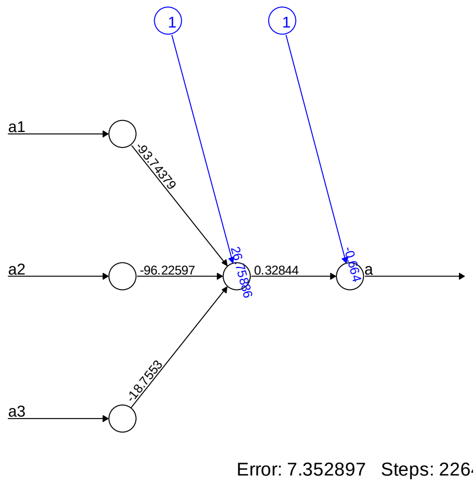




9.22 Tasikmalaya

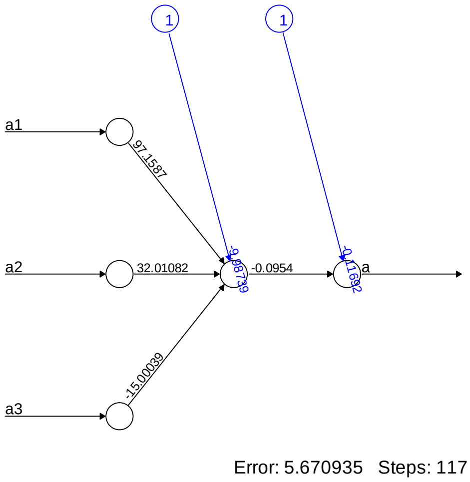
Model	RMSE on Inflow Data		RMSE on Outflow Data	
	In-sample	Out-of-sample	In-sample	Out-of-sample
ARIMAX	69.9	186.3	50.1	181.1
ARIMAX-ANN(3,1,1)	61.5	186.7	48.5	**181.0**
ARIMAX-ANN(3,2,1)	57.3	**178.4**	41.4	195.2
ARIMAX-ANN(3,3,1)	55.6	194.6	40.3	194.1
ARIMAX-ANN(3,4,1)	50.2	185.0	39.6	188.3
ARIMAX-ANN(3,5,1)	50.3	193.8	39.6	191.5

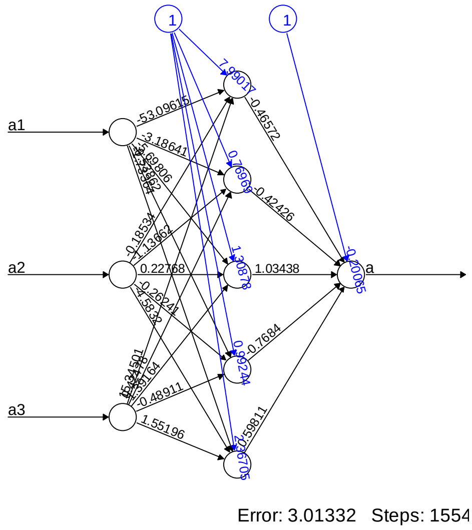




9.23 Cirebon

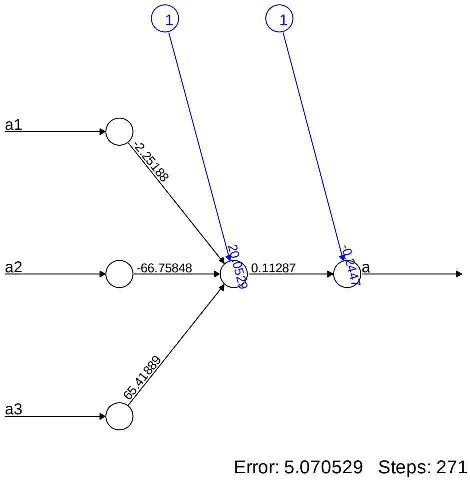
Model	RMSE on Inflow Data		RMSE on Outflow Data	
	In-sample	Out-of-sample	In-sample	Out-of-sample
ARIMAX	125.1	269.7	104.7	187.4
ARIMAX-ANN(3,1,1)	111.9	**259.3**	97.0	186.3
ARIMAX-ANN(3,2,1)	103.2	272.3	92.2	185.9
ARIMAX-ANN(3,3,1)	94.0	282.3	86.4	183.4
ARIMAX-ANN(3,4,1)	90.5	271.3	83.4	185.5
ARIMAX-ANN(3,5,1)	84.4	286.1	82.9	**182.7**

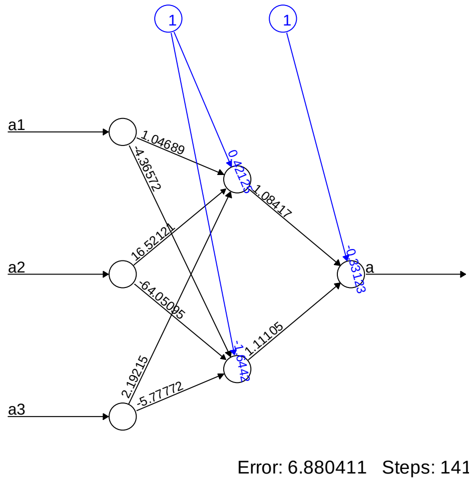




9.24 Jawa Tengah

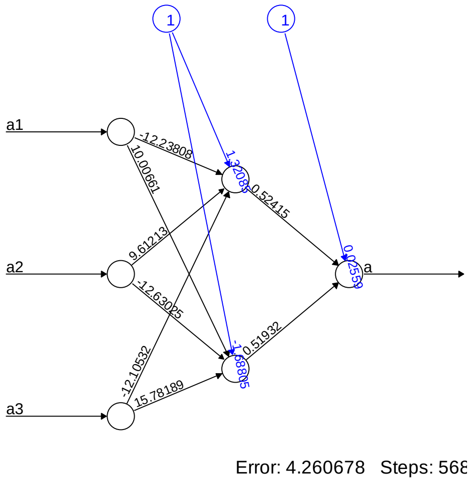
Model	RMSE on Inflow Data		RMSE on Outflow Data	
	In-sample	Out-of-sample	In-sample	Out-of-sample
ARIMAX	255.7	1082.7	222.1	508.7
ARIMAX-ANN(3,1,1)	227.2	**1075.2**	213.0	518.0
ARIMAX-ANN(3,2,1)	207.1	1083.9	200.5	**507.6**
ARIMAX-ANN(3,3,1)	196.4	1079.2	187.7	574.3
ARIMAX-ANN(3,4,1)	180.0	1081.0	185.3	509.9
ARIMAX-ANN(3,5,1)	172.6	1077.2	177.5	519.9





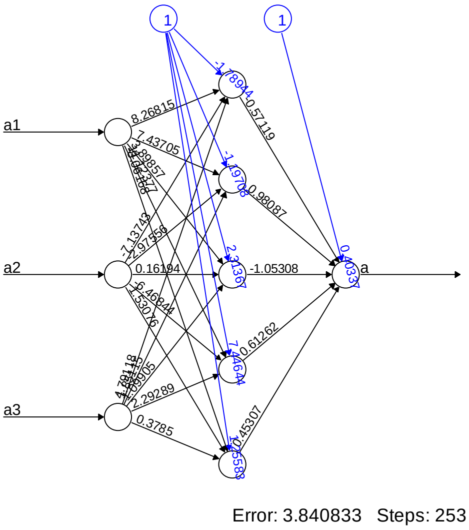
9.25 Yogyakarta

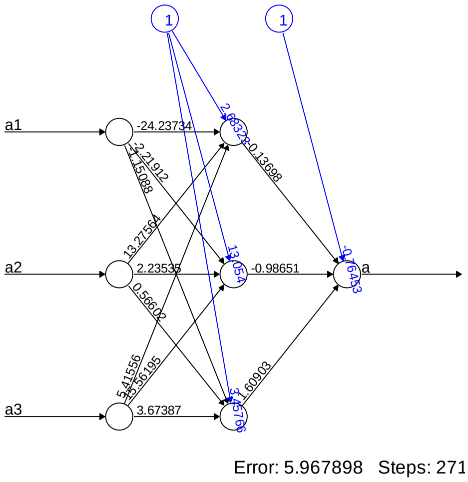
Model	RMSE on Inflow Data		RMSE on Outflow Data	
	In-sample	Out-of-sample	In-sample	Out-of-sample
ARIMAX	124.6	**412.6**	176.8	404.9
ARIMAX-ANN(3,1,1)	115.3	414.0	168.8	404.8
ARIMAX-ANN(3,2,1)	107.7	412.9	154.1	**400.5**
ARIMAX-ANN(3,3,1)	101.5	414.3	143.2	413.1
ARIMAX-ANN(3,4,1)	99.5	418.5	133.2	437.8
ARIMAX-ANN(3,5,1)	92.4	428.0	130.2	405.2



9.26 Solo

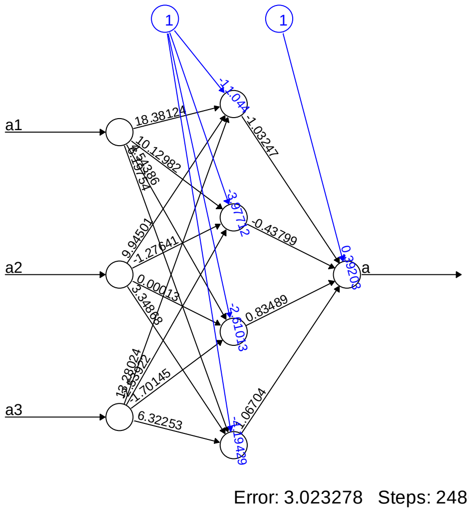
Model	RMSE on Inflow Data		RMSE on Outflow Data	
	In-sample	Out-of-sample	In-sample	Out-of-sample
ARIMAX	165.8	487.7	112.6	332.3
ARIMAX-ANN(3,1,1)	153.6	479.9	107.3	331.5
ARIMAX-ANN(3,2,1)	138.7	486.2	102.2	331.9
ARIMAX-ANN(3,3,1)	135.4	483.8	97.1	**331.1**
ARIMAX-ANN(3,4,1)	126.9	461.6	93.9	339.5
ARIMAX-ANN(3,5,1)	122.6	**442.8**	91.7	332.6

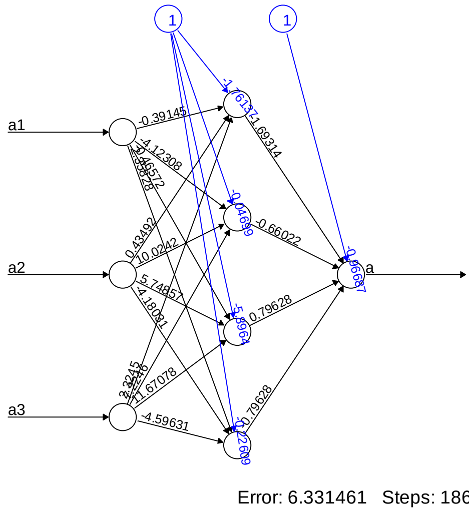




9.27 Purwokerto

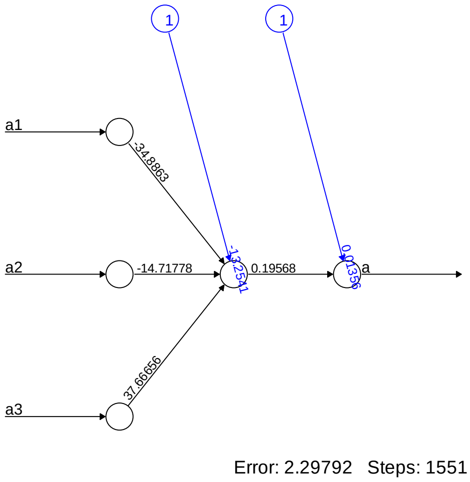
Model	RMSE on Inflow Data		RMSE on Outflow Data	
	In-sample	Out-of-sample	In-sample	Out-of-sample
ARIMAX	81.2	503.9	96.9	339.1
ARIMAX-ANN(3,1,1)	71.1	502.0	89.3	338.7
ARIMAX-ANN(3,2,1)	65.1	504.3	83.9	339.4
ARIMAX-ANN(3,3,1)	61.6	501.3	78.9	347.5
ARIMAX-ANN(3,4,1)	60.7	**500.6**	75.3	**326.9**
ARIMAX-ANN(3,5,1)	58.5	508.0	71.7	359.8

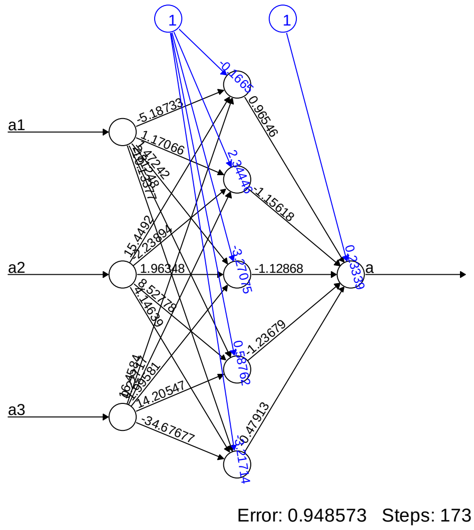




9.28 Tegal

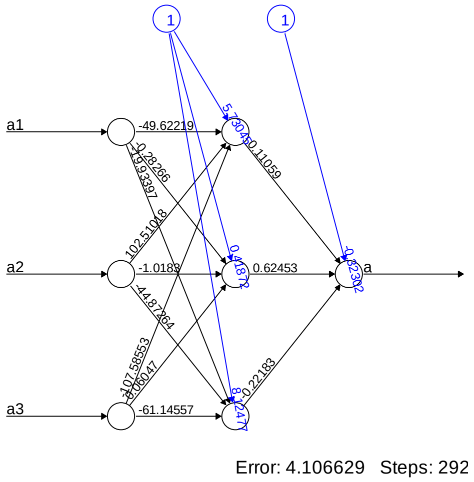
Model	RMSE on Inflow Data		RMSE on Outflow Data	
	In-sample	Out-of-sample	In-sample	Out-of-sample
ARIMAX	88.2	126.6	101.8	185.7
ARIMAX-ANN(3,1,1)	78.7	**124.6**	91.3	179.5
ARIMAX-ANN(3,2,1)	63.2	127.5	75.4	208.0
ARIMAX-ANN(3,3,1)	52.2	131.9	67.3	206.3
ARIMAX-ANN(3,4,1)	37.1	145.8	61.1	204.0
ARIMAX-ANN(3,5,1)	37.3	182.1	53.3	**170.5**

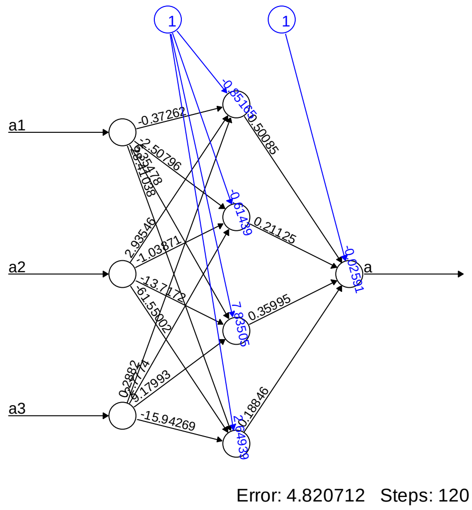




9.29 Jawa Timur

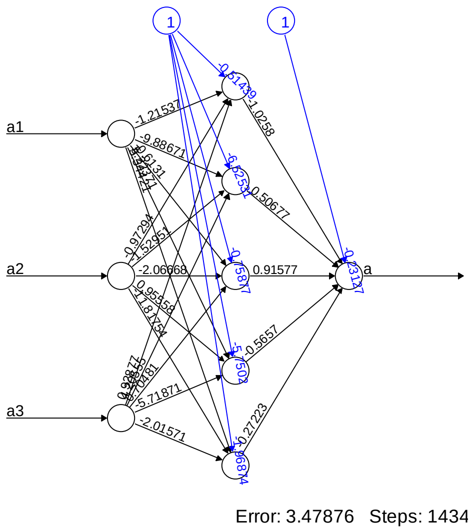
Model	RMSE on Inflow Data		RMSE on Outflow Data	
	In-sample	Out-of-sample	In-sample	Out-of-sample
ARIMAX	314.3	1070.4	302.6	1004.2
ARIMAX-ANN(3,1,1)	297.1	1067.9	278.5	990.6
ARIMAX-ANN(3,2,1)	274.6	1070.1	261.9	991.7
ARIMAX-ANN(3,3,1)	271.6	**1064.4**	254.8	975.6
ARIMAX-ANN(3,4,1)	255.6	1066.9	242.7	**959.9**
ARIMAX-ANN(3,5,1)	253.9	1068.3	235.4	966.0

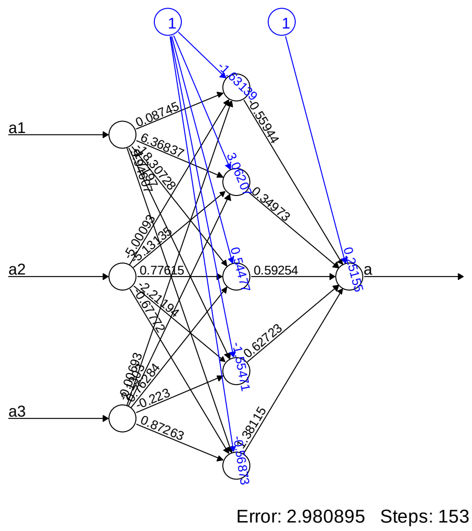




9.30 Malang

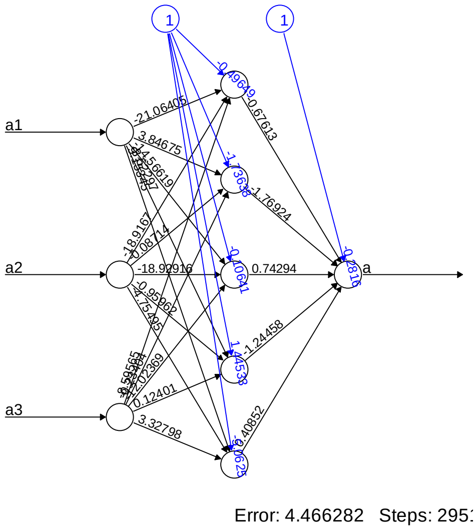
Model	RMSE on Inflow Data		RMSE on Outflow Data	
	In-sample	Out-of-sample	In-sample	Out-of-sample
ARIMAX	119.9	535.1	106.0	483.8
ARIMAX-ANN(3,1,1)	108.8	532.0	101.3	484.0
ARIMAX-ANN(3,2,1)	102.0	547.8	96.6	483.9
ARIMAX-ANN(3,3,1)	94.2	550.6	92.6	484.3
ARIMAX-ANN(3,4,1)	84.9	553.5	88.5	496.7
ARIMAX-ANN(3,5,1)	86.0	**512.8**	85.3	**458.9**

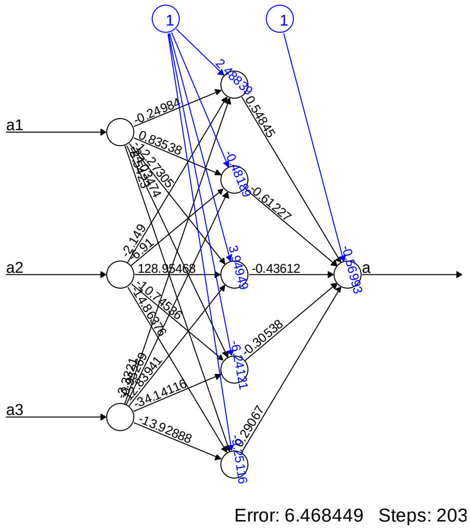




9.31 Kediri

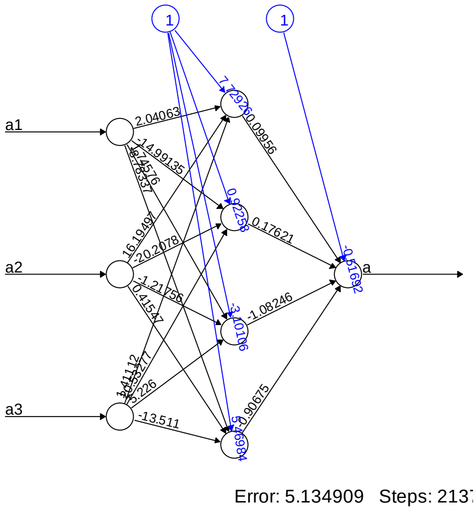
Model	RMSE on Inflow Data		RMSE on Outflow Data	
	In-sample	Out-of-sample	In-sample	Out-of-sample
ARIMAX	111.2	546.9	145.0	436.3
ARIMAX-ANN(3,1,1)	99.3	543.3	138.9	445.9
ARIMAX-ANN(3,2,1)	94.4	543.6	132.3	429.0
ARIMAX-ANN(3,3,1)	86.6	541.4	128.3	424.6
ARIMAX-ANN(3,4,1)	83.3	545.5	121.5	427.6
ARIMAX-ANN(3,5,1)	84.3	**539.1**	119.0	**415.9**

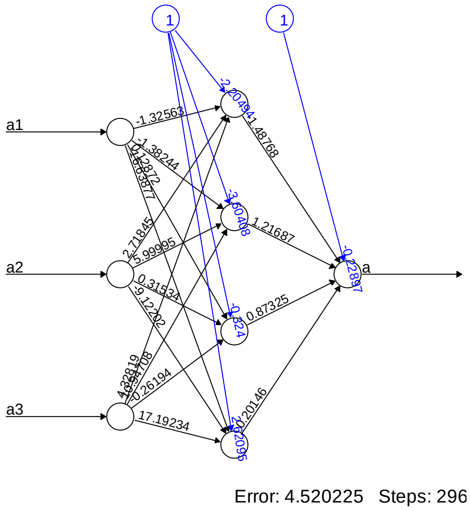




9.32 Jember

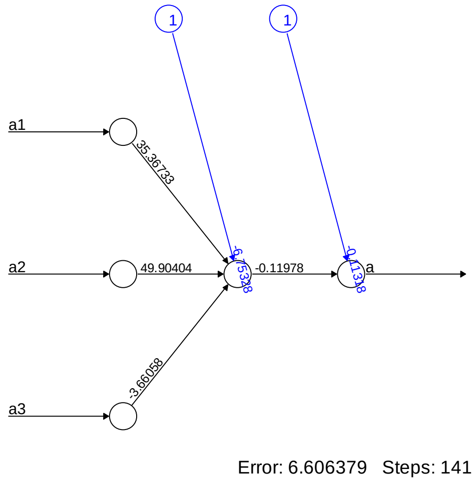
Model	RMSE on Inflow Data		RMSE on Outflow Data	
	In-sample	Out-of-sample	In-sample	Out-of-sample
ARIMAX	69.0	199.7	75.3	248.8
ARIMAX-ANN(3,1,1)	62.2	199.1	71.2	248.4
ARIMAX-ANN(3,2,1)	58.4	201.8	64.1	248.1
ARIMAX-ANN(3,3,1)	54.7	203.9	60.8	250.2
ARIMAX-ANN(3,4,1)	55.6	**188.3**	59.3	**247.1**
ARIMAX-ANN(3,5,1)	53.1	193.4	56.8	254.5

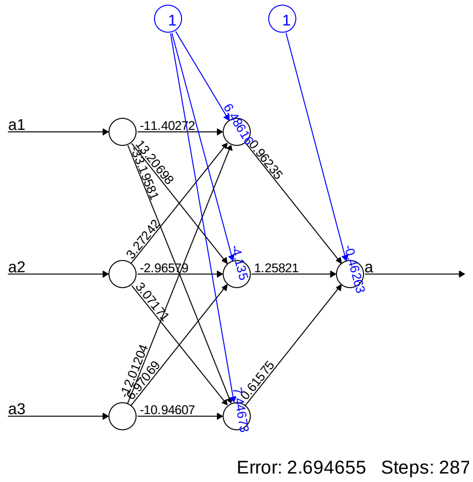




9.33 Bali

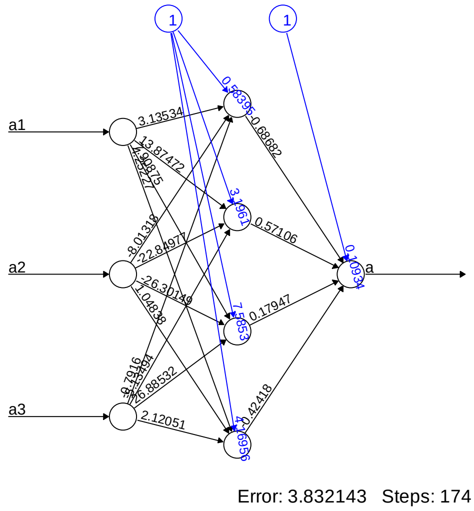
Model	RMSE on Inflow Data		RMSE on Outflow Data	
	In-sample	Out-of-sample	In-sample	Out-of-sample
ARIMAX	136.8	337.6	205.7	**303.2**
ARIMAX-ANN(3,1,1)	124.7	**329.9**	193.7	315.5
ARIMAX-ANN(3,2,1)	115.1	340.8	165.9	495.1
ARIMAX-ANN(3,3,1)	108.9	342.1	154.2	304.9
ARIMAX-ANN(3,4,1)	104.4	336.3	151.6	306.3
ARIMAX-ANN(3,5,1)	100.6	341.4	150.1	306.1

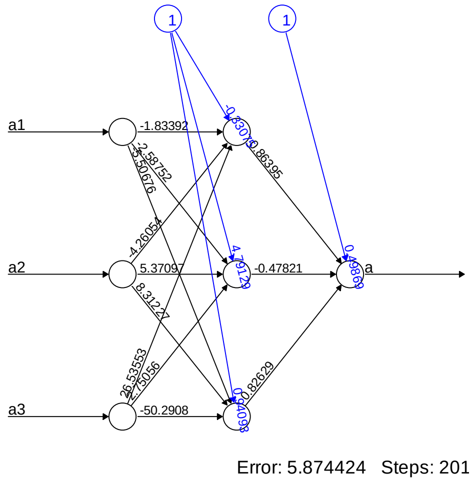




9.34 Nusa Tenggara Barat

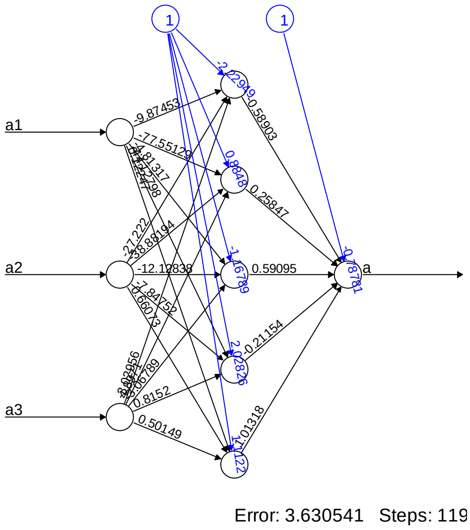
Model	RMSE on Inflow Data		RMSE on Outflow Data	
	In-sample	Out-of-sample	In-sample	Out-of-sample
ARIMAX	55.0	167.0	85.6	127.2
ARIMAX-ANN(3,1,1)	52.3	166.3	82.0	133.9
ARIMAX-ANN(3,2,1)	48.1	164.4	76.4	132.2
ARIMAX-ANN(3,3,1)	47.2	166.0	72.6	**119.6**
ARIMAX-ANN(3,4,1)	45.0	**162.4**	69.3	134.4
ARIMAX-ANN(3,5,1)	43.2	167.5	66.2	164.5

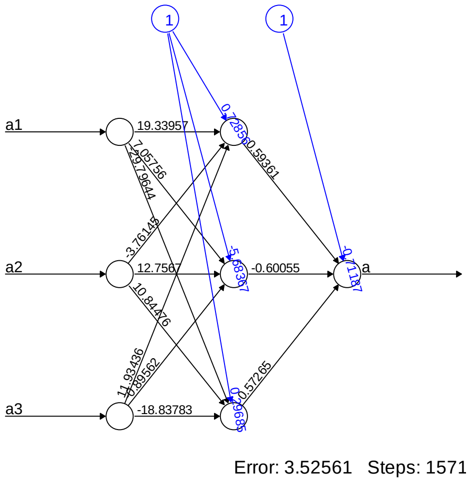




9.35 Nusa Tenggara Timur

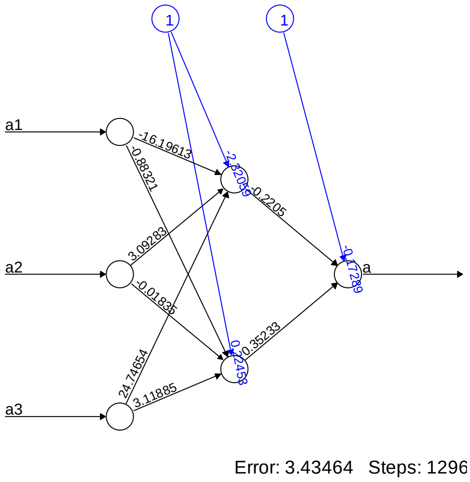
Model	RMSE on Inflow Data		RMSE on Outflow Data	
	In-sample	Out-of-sample	In-sample	Out-of-sample
ARIMAX	39.6	109.1	58.1	189.9
ARIMAX-ANN(3,1,1)	36.8	109.8	52.9	189.6
ARIMAX-ANN(3,2,1)	33.9	110.7	48.8	191.9
ARIMAX-ANN(3,3,1)	32.4	102.6	46.7	**188.3**
ARIMAX-ANN(3,4,1)	31.6	102.6	47.3	192.5
ARIMAX-ANN(3,5,1)	30.4	**100.2**	44.3	196.9

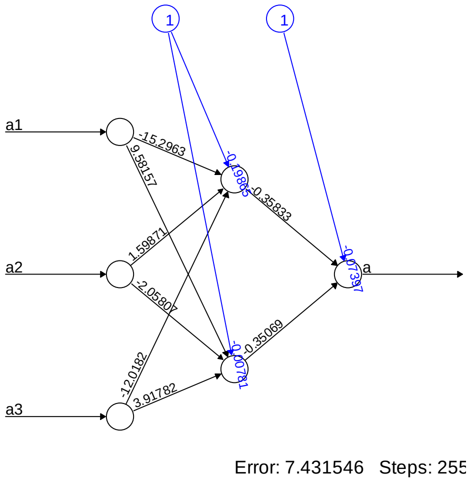




9.36 Kalimantan Selatan

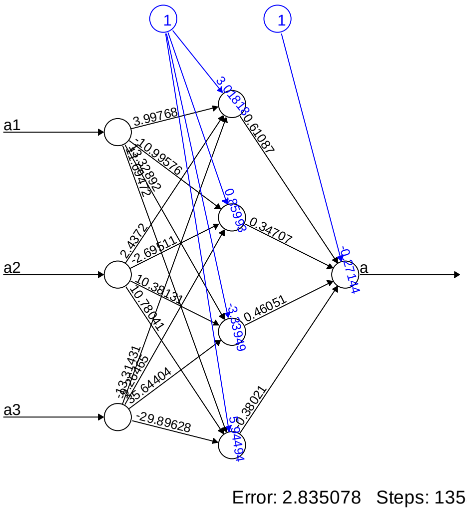
Model	RMSE on Inflow Data		RMSE on Outflow Data	
	In-sample	Out-of-sample	In-sample	Out-of-sample
ARIMAX	92.6	298.2	81.9	158.5
ARIMAX-ANN(3,1,1)	80.7	308.8	78.3	163.6
ARIMAX-ANN(3,2,1)	76.1	**278.2**	75.2	**153.5**
ARIMAX-ANN(3,3,1)	70.0	284.6	69.5	156.9
ARIMAX-ANN(3,4,1)	67.9	288.0	66.3	183.7
ARIMAX-ANN(3,5,1)	64.3	292.0	65.5	179.1

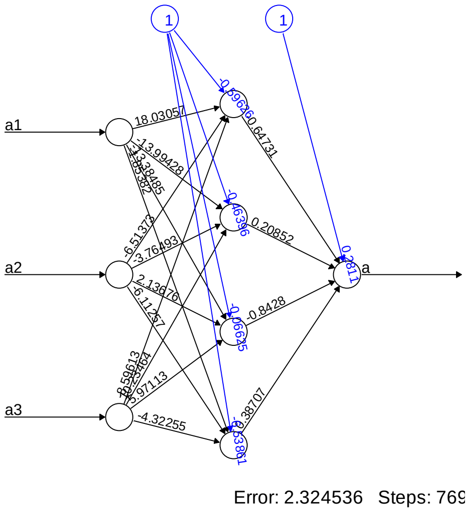




9.37 Kalimantan Barat

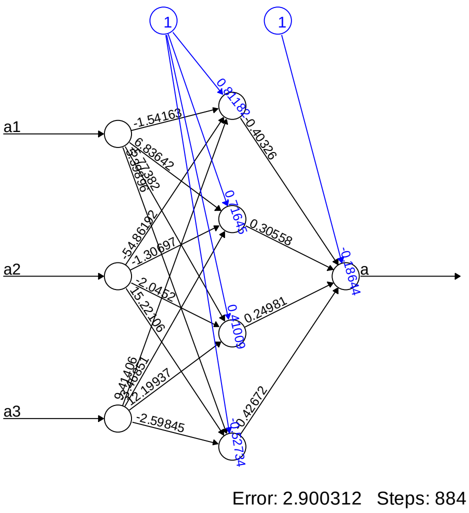
Model	RMSE on Inflow Data		RMSE on Outflow Data	
	In-sample	Out-of-sample	In-sample	Out-of-sample
ARIMAX	68.3	349.8	139.1	295.3
ARIMAX-ANN(3,1,1)	59.8	345.1	134.3	285.1
ARIMAX-ANN(3,2,1)	56.3	347.1	119.7	310.7
ARIMAX-ANN(3,3,1)	51.2	342.5	115.0	314.8
ARIMAX-ANN(3,4,1)	48.0	**340.0**	109.0	**279.6**
ARIMAX-ANN(3,5,1)	44.8	343.8	104.0	288.9

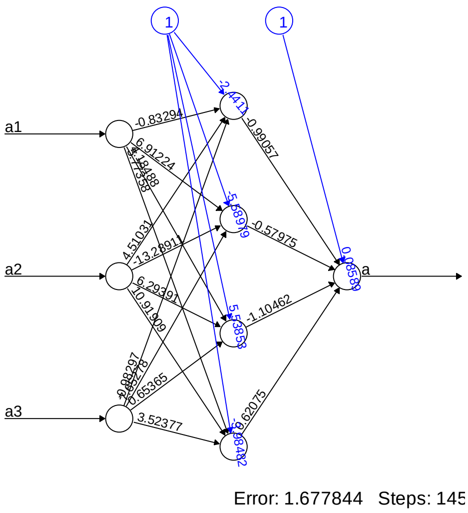




9.38 Kalimantan Timur

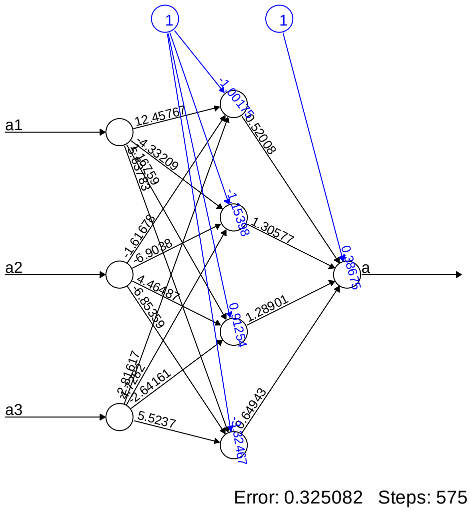
Model	RMSE on Inflow Data		RMSE on Outflow Data	
	In-sample	Out-of-sample	In-sample	Out-of-sample
ARIMAX	74.6	168.7	172.7	331.0
ARIMAX-ANN(3,1,1)	67.5	167.7	161.7	330.6
ARIMAX-ANN(3,2,1)	60.2	173.2	140.1	328.7
ARIMAX-ANN(3,3,1)	57.4	179.7	129.4	330.2
ARIMAX-ANN(3,4,1)	52.6	**166.1**	116.1	**327.0**
ARIMAX-ANN(3,5,1)	47.3	176.6	113.7	330.2

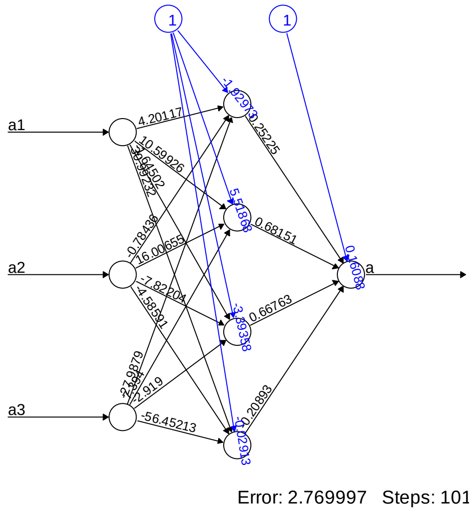




9.39 Kalimantan Tengah

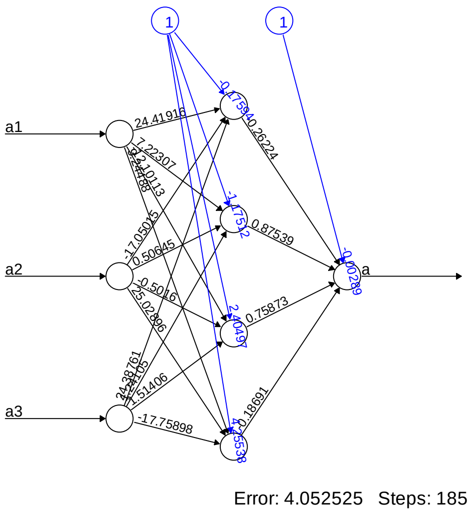
Model	RMSE on Inflow Data		RMSE on Outflow Data	
	In-sample	Out-of-sample	In-sample	Out-of-sample
ARIMAX	39.2	132.2	78.7	214.6
ARIMAX-ANN(3,1,1)	31.2	106.2	76.6	214.7
ARIMAX-ANN(3,2,1)	24.0	113.9	68.2	213.7
ARIMAX-ANN(3,3,1)	15.8	111.5	61.6	214.2
ARIMAX-ANN(3,4,1)	13.2	**98.2**	60.5	**213.3**
ARIMAX-ANN(3,5,1)	12.5	105.5	58.4	215.5





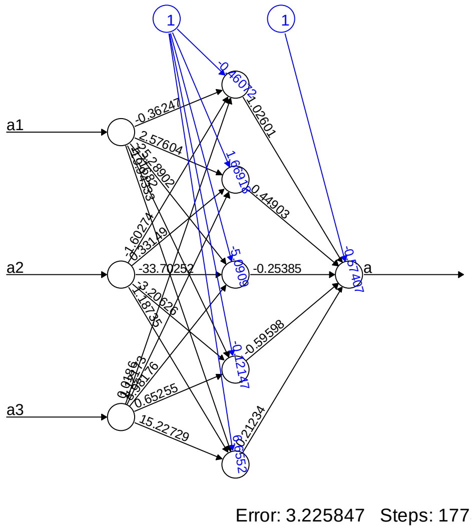
9.40 Balikpapan

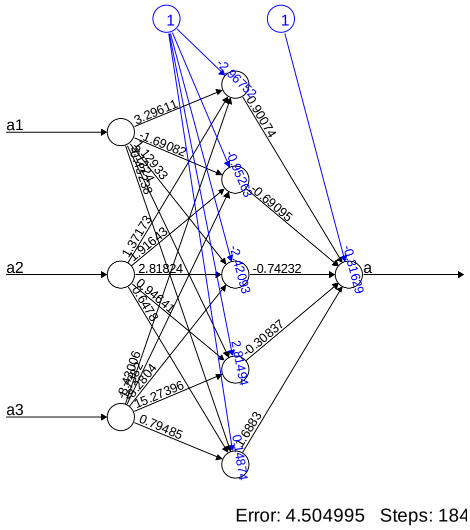
Model	RMSE on Inflow Data		RMSE on Outflow Data	
	In-sample	Out-of-sample	In-sample	Out-of-sample
ARIMAX	31.2	137.0	82.2	**192.0**
ARIMAX-ANN(3,1,1)	28.5	138.6	78.3	199.5
ARIMAX-ANN(3,2,1)	26.4	137.6	75.5	194.1
ARIMAX-ANN(3,3,1)	25.1	141.6	72.3	196.9
ARIMAX-ANN(3,4,1)	23.5	**134.1**	70.0	204.4
ARIMAX-ANN(3,5,1)	22.0	137.1	69.5	196.9



9.41 Sulawesi Selatan

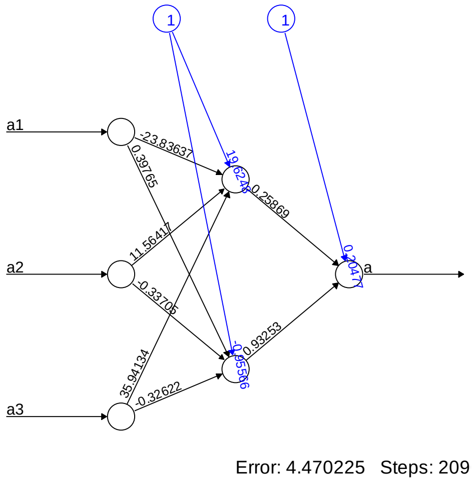
Model	RMSE on Inflow Data		RMSE on Outflow Data	
	In-sample	Out-of-sample	In-sample	Out-of-sample
ARIMAX	164.8	393.2	171.9	322.3
ARIMAX-ANN(3,1,1)	145.9	385.4	165.5	314.4
ARIMAX-ANN(3,2,1)	138.3	384.7	157.1	319.7
ARIMAX-ANN(3,3,1)	131.6	379.6	149.7	335.7
ARIMAX-ANN(3,4,1)	125.4	398.7	144.4	331.7
ARIMAX-ANN(3,5,1)	122.0	**376.4**	135.7	**300.6**

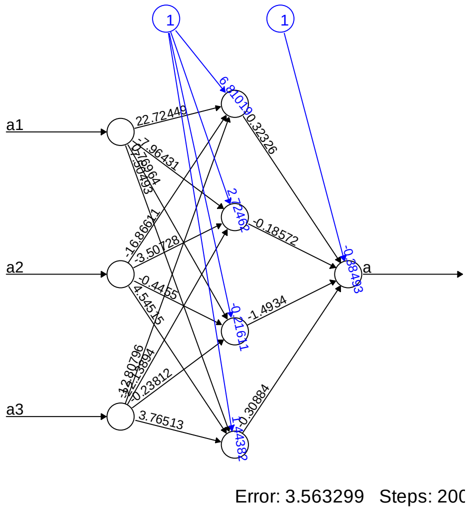




9.42 Sulawesi Tengah

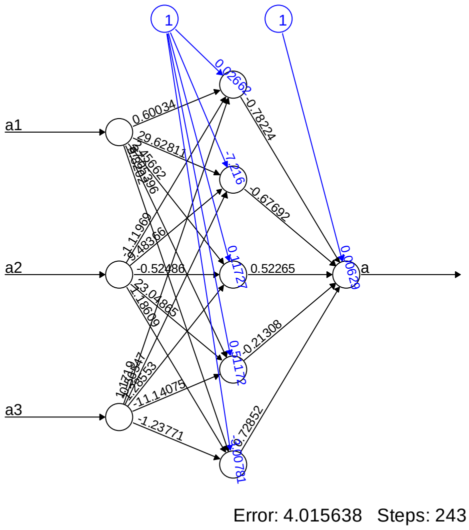
Model	RMSE on Inflow Data		RMSE on Outflow Data	
	In-sample	Out-of-sample	In-sample	Out-of-sample
ARIMAX	35.1	170.9	69.6	134.9
ARIMAX-ANN(3,1,1)	32.9	168.4	65.7	137.2
ARIMAX-ANN(3,2,1)	31.6	**167.0**	61.9	136.3
ARIMAX-ANN(3,3,1)	30.1	167.6	60.5	138.7
ARIMAX-ANN(3,4,1)	29.2	167.9	58.2	**125.8**
ARIMAX-ANN(3,5,1)	28.9	170.9	58.8	134.4

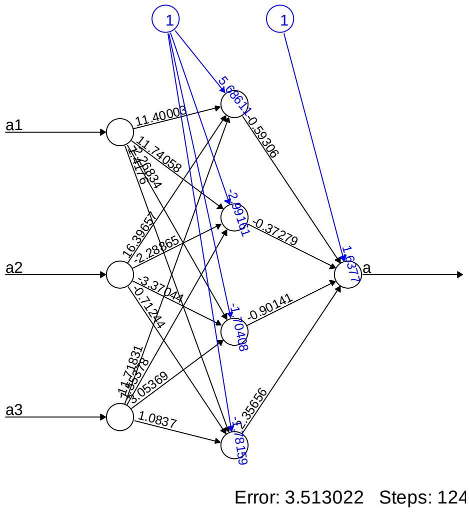




9.43 Sulawesi Utara

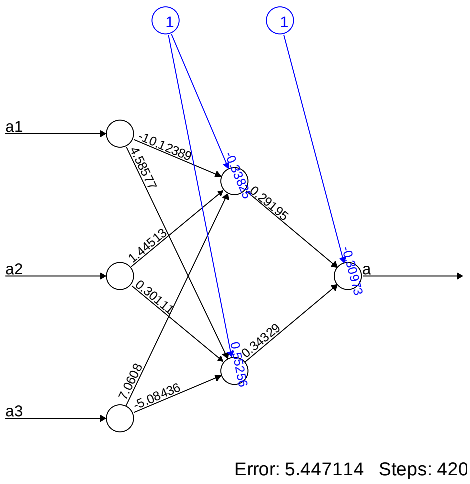
Model	RMSE on Inflow Data		RMSE on Outflow Data	
	In-sample	Out-of-sample	In-sample	Out-of-sample
ARIMAX	43.2	294.6	107.5	255.0
ARIMAX-ANN(3,1,1)	40.9	294.8	103.5	237.7
ARIMAX-ANN(3,2,1)	38.5	293.5	94.4	273.5
ARIMAX-ANN(3,3,1)	37.3	292.1	91.4	240.5
ARIMAX-ANN(3,4,1)	36.0	294.7	83.1	**227.9**
ARIMAX-ANN(3,5,1)	34.3	**290.6**	81.7	239.9

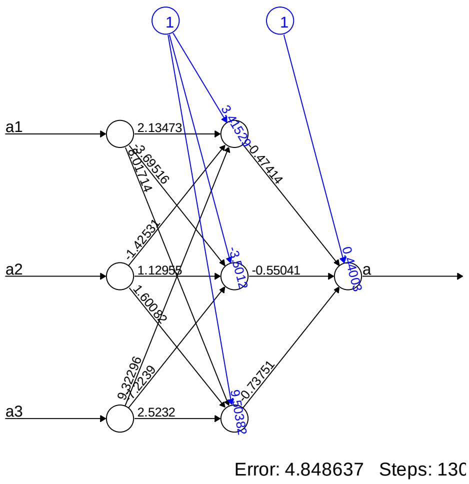




9.44 Sulawesi Tenggara

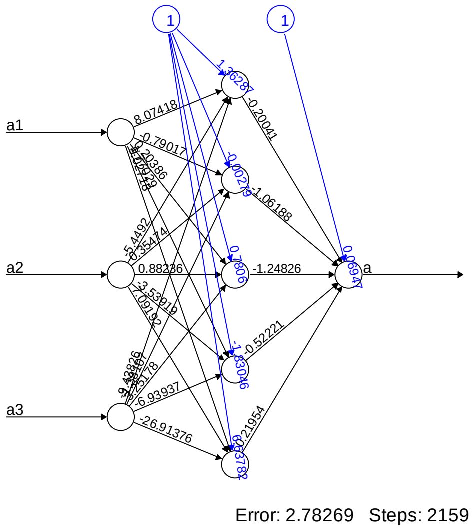
Model	RMSE on Inflow Data		RMSE on Outflow Data	
	In-sample	Out-of-sample	In-sample	Out-of-sample
ARIMAX	35.4	148.7	73.6	153.5
ARIMAX-ANN(3,1,1)	32.1	143.6	69.6	151.9
ARIMAX-ANN(3,2,1)	31.0	**133.4**	64.9	154.9
ARIMAX-ANN(3,3,1)	29.4	134.8	62.4	**151.0**
ARIMAX-ANN(3,4,1)	28.9	141.2	60.5	153.8
ARIMAX-ANN(3,5,1)	28.3	138.2	57.7	179.1

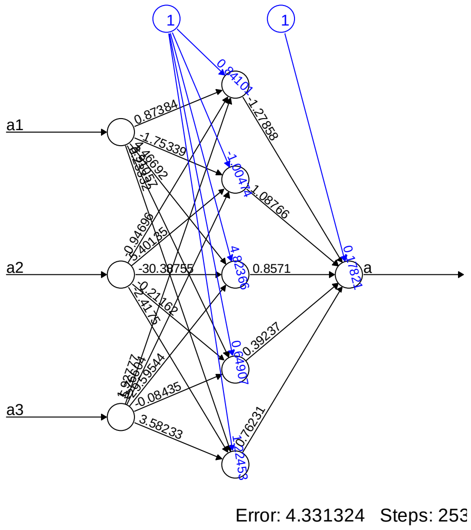




9.45 Maluku

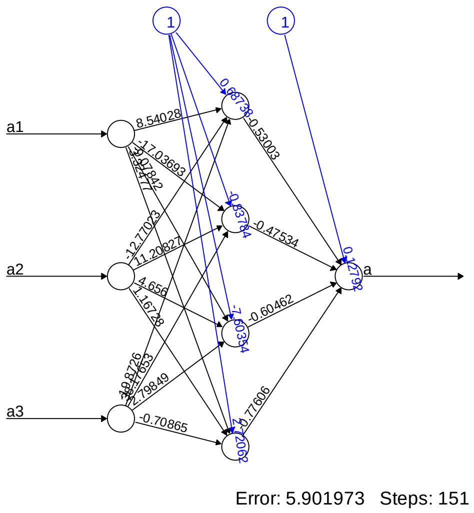
Model	RMSE on Inflow Data		RMSE on Outflow Data	
	In-sample	Out-of-sample	In-sample	Out-of-sample
ARIMAX	33.7	83.3	60.5	72.5
ARIMAX-ANN(3,1,1)	30.0	81.7	58.2	74.2
ARIMAX-ANN(3,2,1)	28.7	84.8	53.7	77.7
ARIMAX-ANN(3,3,1)	27.5	81.9	51.7	73.6
ARIMAX-ANN(3,4,1)	27.0	82.6	50.5	73.6
ARIMAX-ANN(3,5,1)	26.0	**79.3**	47.6	**68.4**

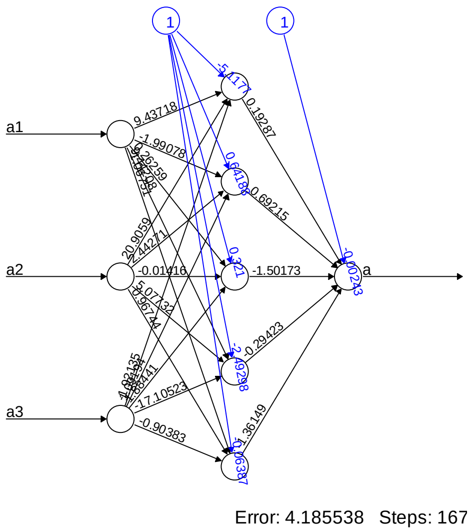




9.46 Maluku Utara

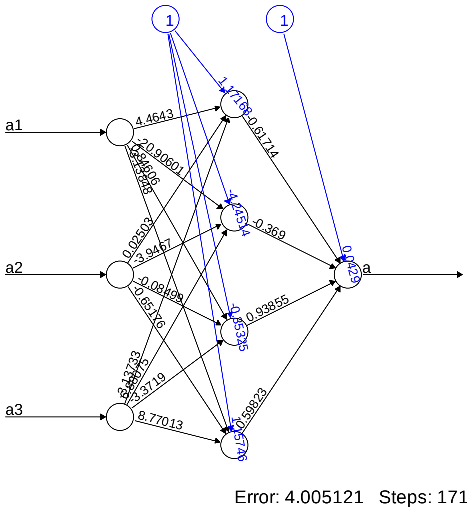
Model	RMSE on Inflow Data		RMSE on Outflow Data	
	In-sample	Out-of-sample	In-sample	Out-of-sample
ARIMAX	14.2	27.6	35.5	59.2
ARIMAX-ANN(3,1,1)	13.2	27.8	33.8	60.4
ARIMAX-ANN(3,2,1)	12.3	27.6	31.3	59.7
ARIMAX-ANN(3,3,1)	11.8	27.9	29.8	59.8
ARIMAX-ANN(3,4,1)	11.4	**27.1**	28.6	63.4
ARIMAX-ANN(3,5,1)	10.6	30.2	27.6	**54.2**

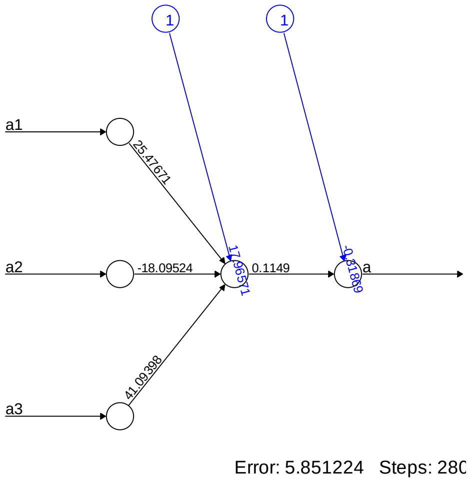




9.47 Papua

Model	RMSE on Inflow Data		RMSE on Outflow Data	
	In-sample	Out-of-sample	In-sample	Out-of-sample
ARIMAX	90.2	322.4	167.1	294.1
ARIMAX-ANN(3,1,1)	84.8	329.5	157.1	**280.9**
ARIMAX-ANN(3,2,1)	79.6	325.1	133.1	281.9
ARIMAX-ANN(3,3,1)	73.8	325.8	125.4	315.5
ARIMAX-ANN(3,4,1)	70.0	**321.0**	120.6	314.4
ARIMAX-ANN(3,5,1)	62.1	334.3	116.1	310.8





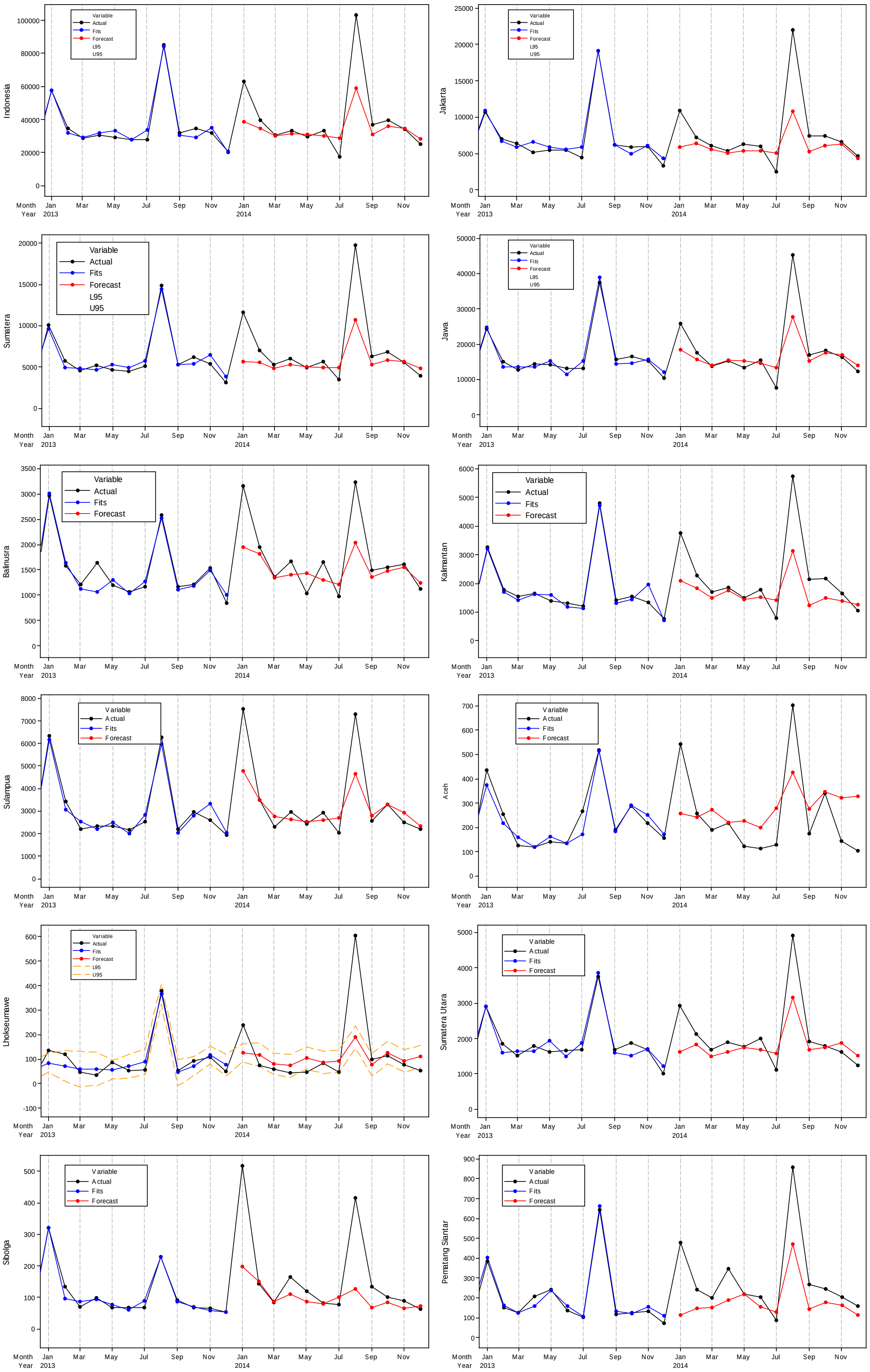
Appendix 10. Final Model for Currency Inflow Data

i	Series	ARIMA	X	ANN	GARCH
1	Indonesia	$(2,0,0)(1,0,0)^{12}$	t Ht Htm1 S48 A95 A96 A97 A98 A121	(3,5,1)	-
2	Jakarta	$([1,3,4],0,0)(1,0,0)^{12}$	t Ht Htm1 S41 A95 A96 A97 A121 A73 A99	(3,4,1)	-
3	Sumatera	$([1,2,10),0,0)(1,0,0)^{12}$	t Ht Htm1 S50 A97 A121	(3,5,1)	(0,[2])
4	Jawa	$([1,3],0,0)(1,0,0)^{12}$	t Ht Htm1 S48 A1 A95 A96 A97 A121	(3,3,1)	-
5	Balinusra	$(2,0,0)(1,0,0)^{12}$	t Ht Htm1 S49 A121 A97 A98	(3,5,1)	-
6	Kalimantan	$(1,0,0)(1,0,0)^{12}$	Ht Htm1 A1 A97 A98 A121 A115	(3,1,1)	-
7	Sulampua	$(1,0,0)(1,0,0)^{12}$	t Ht Htm1 S50 A1 A31 A97 A98 A109 A121	(3,3,1)	-
8	Jakarta	$([1,3,4],0,0)(1,0,0)^{12}$	t Ht Htm1 S41 A95 A96 A97 A121 A73 A99	(3,4,1)	-
9	Aceh	$(1,0,[2])(1,0,0)^{12}$	t Ht Htm1 S50 A121 A29 A97 A119	(3,5,1)	-
10	Lhokseumawe	$([2],0,1)(1,0,0)^{12}$	t S48 A1	(3,1,1)	(0,[2])
11	Sumatera Utara	$([1,3],0,0)(1,0,0)^{12}$	t Ht Htm1 A95 A97 A121	(3,4,1)	-
12	Sibolga	$([2,3],0,1)(1,0,0)^{12}$	t Ht Htm1 A121 A97 A73 A41 A98	(3,4,1)	-
13	Pematang Siantar	$(1,0,0)(1,0,0)^{12}$	t Ht Htm1 A121 A109	(3,4,1)	-
14	Bengkulu	$(1,0,0)(1,0,0)^{12}$	t Ht Htm1 A121 A97 A61 A73 A120 S50 S119	(3,1,1)	(0,1)
15	Jambi	$(1,0,[6])(1,0,0)^{12}$	t Ht Htm1 S48 S97 A1 A49 A73 A99 A107 A109 A118 A121	(3,3,1)	(0,[7])
16	Sumatera Barat	$([1,5],0,[3])(1,0,0)^{12}$	t Ht Htm1	(3,4,1)	-
17	Riau	$(1,0,[6])(1,0,0)^{12}$	t Ht Htm1 S48 A49 A1 S2 S131 A121 A99 A109	(3,4,1)	(0,1)
18	Kepulauan Riau	$([1,3],0,[4])(1,0,0)^{12}$	t Ht Htm1 A1 S41	(3,5,1)	-
19	Sumatera Selatan	$(2,0,[3])(1,0,0)^{12}$	t Ht Htm1 S48 A97 A121 A130 A73 A98	(3,5,1)	-
20	Lampung	$(1,0,0)(1,0,0)^{12}$	t Ht Htm1 A121 A109 A95	(3,5,1)	-
21	Jawa Barat	$([2],0,[1,5])(1,0,0)^{12}$	t Ht Htm1 A1 A13 S48 A49 A97 A73 A98 A68 A95 A86 A96	(3,2,1)	-
22	Tasikmalaya	$(3,0,0)(1,0,0)^{12}$	t Ht Htm1 A1 S48 A121 S97 A99 S52 A31	(3,2,1)	-
23	Cirebon	$(3,0,0)(1,0,0)^{12}$	t Ht Htm1 A1 S48 A97 A98 A121	(3,1,1)	(0,[2])
24	Jawa Tengah	$([1,3],0,0)(1,0,0)^{12}$	t Ht Htm1 A95 A121 A97 A96	(3,1,1)	(0,[3])
25	Yogyakarta	$(1,0,[3])(1,0,0)^{12}$	t Ht Htm1 A1 A97 S45 A98 A114 A31	-	(0,[3])
26	Solo	$(1,0,0)(1,0,0)^{12}$	t Ht Htm1 S46 A1 A97 A121 A119	(3,5,1)	-
27	Purwokerto	$(2,0,[3])(1,0,0)^{12}$	t Ht Htm1 S48 A1 A130 A121 A109 A95 A96	(3,4,1)	-
28	Tegal	(1,0,0)	t Ht Htm1 A121	(3,1,1)	-
29	Jawa Timur	$(1,0,0)(1,0,0)^{12}$	t Ht Htm1 S48 A1 A97 A121 A95 A79	(3,3,1)	-
30	Malang	$([2],0,1)(1,0,0)^{12}$	t Ht Htm1 S48 A1 A95 A97	(3,5,1)	-
31	Kediri	$(2,0,0)(1,0,0)^{12}$	t Ht Htm1 A1 S48 A97 A121	(3,5,1)	-
32	Jember	$([1,3],0,0)(1,0,0)^{12}$	t Ht Htm1 A1 S48 A97 A121 A95	(3,4,1)	-
33	Bali	$([1,3],0,[2])(1,0,0)^{12}$	t Ht Htm1 A1 S48 A121	(3,1,1)	(0,[3])
34	Nusa Tenggara Barat	$(2,0,0)(1,0,0)^{12}$	t Ht Htm1 S48 A1 A29 A97 A98	(3,4,1)	-
35	Nusa Tenggara Timur	$(2,0,0)(1,0,0)^{12}$	t Ht Htm1 A1 S48 A97 A98 A121 A86	(3,5,1)	-
36	Kalimantan Selatan	$([1,3],0,0)(1,0,0)^{12}$	t Ht Htm1 S48 A95 A115 A121 A109	(3,2,1)	(0,[5])
37	Kalimantan Barat	$([1,3],0,[2])(1,0,0)^{12}$	t Ht Htm1 S48 A97 A121 A74	(3,4,1)	-
38	Kalimantan Timur	$([2,3],0,0)(1,0,0)^{12}$	t Ht Htm1 S41 A1 A95 A97	(3,4,1)	-
39	Kalimantan Tengah	(0,0,0)(0,0,0)12	t Ht Htm1 A121	(3,4,1)	(0,1)
40	Balikpapan	$(1,0,0)(1,0,0)^{12}$	t Ht Htm1 S48 A1 A97 A98 A121 A62	(3,4,1)	(0,[2])
41	Sulawesi Selatan	$(2,0,0)(1,0,0)^{12}$	t Ht Htm1 S48 A97 A98	(3,5,1)	-
42	Sulawesi Tengah	$(1,0,[5])(1,0,0)^{12}$	t Ht Htm1 S48 A1 A121 A49	(3,2,1)	-
43	Sulawesi Utara	$(1,0,0)(1,0,0)^{12}$	t Ht Htm1 S48 A1 A97 A61 A73 A109 A121 A98 A119	(3,5,1)	-
44	Sulawesi Tenggara	$(2,0,0)(1,0,0)^{12}$	Ht Htm1 S50 A85 A74	(3,2,1)	(0,[2])
45	Maluku	$(1,0,0)(1,0,0)^{12}$	Ht Htm1 S48 A97 A121 A114	(3,5,1)	-
46	Maluku Utara	$(1,0,[2])(1,0,0)^{12}$	t Ht Htm1 S48 A1 A97 A98	(3,4,1)	-
47	Papua	$(1,0,[4])(1,0,0)^{12}$	t Ht Htm1 A121 A97 A73	(3,4,1)	-

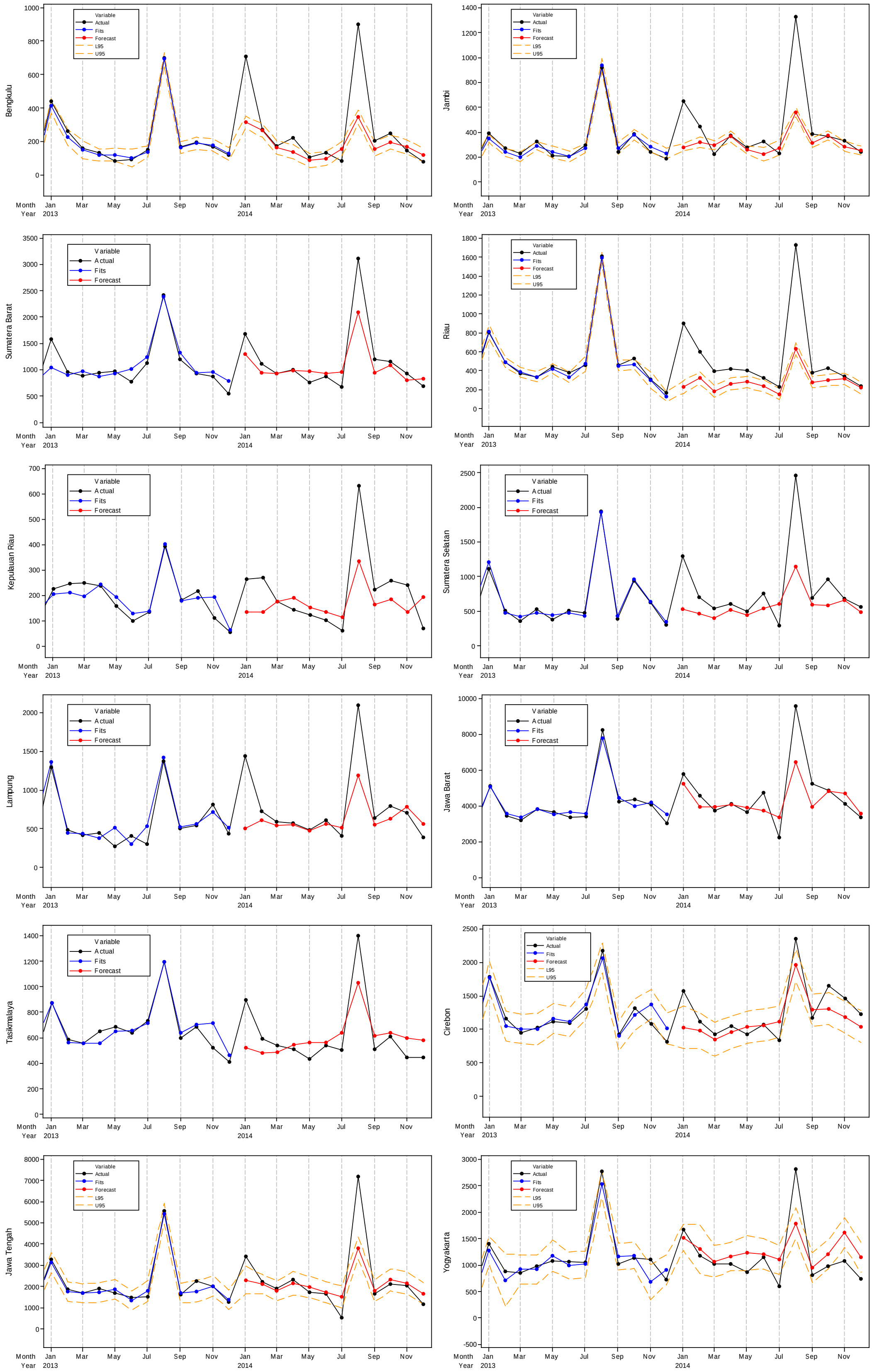
Appendix 11. Final Model for Currency Outflow Data

i	Series	ARIMA	X	ANN	GARCH
1	Indonesia	$([1,3],0,0)(1,0,0)^{12}$	t S49 A96	(3,1,1)	(0,1)
2	Jakarta	$([1,3],0,0)(1,0,0)^{12}$	t S40 A84	(3,4,1)	(0,1)
3	Sumatera	$([1,3],0,0)(1,0,0)^{12}$	t S49 A95 A96	(3,3,1)	-
4	Jawa	$([1,3],0,0)(1,0,0)^{12}$	t S48	(3,5,1)	-
5	Balinusra	$([1,3],0,0)(1,0,0)^{12}$	t S49	(3,4,1)	-
6	Kalimantan	$(2,0,0)(1,0,0)^{12}$	t S49 A95 A96 A132	(3,5,1)	-
7	Sulampua	$([2,3,4,6],0,1)(1,0,0)^{12}$	t A96	(3,2,1)	-
8	Jakarta	$([1,3],0,0)(1,0,0)^{12}$	t S40 A84	(3,4,1)	(0,1)
9	Aceh	$(2,0,0)(1,0,0)^{12}$	t S49	-	-
10	Lhokseumawe	$(1,0,0)(1,0,0)^{12}$	t A83 A95 A60	(3,3,1)	(0,1)
11	Sumatera Utara	$([1,3,5,12],0,0)(1,0,0)^{12}$	t S48 A96	(3,5,1)	-
12	Sibolga	(2,0,0)(1,0,0)12	t A95 A96	(3,3,1)	(0,[5])
13	Pematang Siantar	$(1,0,0)(1,0,0)^{12}$	A125	(3,2,1)	-
14	Bengkulu	$([1,3],0,0)(1,0,0)^{12}$	t S49 A95 A96 A90	(3,2,1)	(0,[5])
15	Jambi	$(2,0,0)(1,0,0)^{12}$	t S48 A95 A96	(3,1,1)	-
16	Sumatera Barat	$([2],0,0)(1,0,0)^{12}$	t S49 A95 A96	(3,1,1)	-
17	Riau	$([1,3],0,0)(1,0,0)^{12}$	t A96 A66	-	(0,[12])
18	Kepulauan Riau	$(2,0,0)(1,0,0)^{12}$	t S43 A95 A96	(3,4,1)	-
19	Sumatera Selatan	$([2],0,0)(1,0,0)^{12}$	t S48 A96	-	(0,[2])
20	Lampung	$(1,0,0)(1,0,0)^{12}$	t S49 A95	-	(0,1)
21	Jawa Barat	$([1,3],0,0)(1,0,0)^{12}$	t S48	(3,4,1)	-
22	Tasikmalaya	$([2,3,4],0,0)(1,0,0)^{12}$	t S48 A96	(3,1,1)	-
23	Cirebon	$(2,0,0)(1,0,0)^{12}$	t S48	(3,5,1)	-
24	Jawa Tengah	$([2,3],0,0)(1,0,0)^{12}$	t S41 A84	(3,2,1)	(0,[5])
25	Di Yogyakarta	$([1,3],0,0)(1,0,0)^{12}$	t S49	(3,2,1)	-
26	Solo	$([2,3],0,0)(1,0,0)^{12}$	t S49 A96	(3,3,1)	-
27	Purwokerto	$([1,3],0,0)(1,0,0)^{12}$	t S48 A60 A120	(3,4,1)	-
28	Tegal	(1,0,0)(1,0,0)12	t	(3,5,1)	-
29	Jawa Timur	$([2,3,4,6],0,0)(1,0,0)^{12}$	t S48 A84	(3,4,1)	(0,[6])
30	Malang	$(2,0,0)(1,0,0)^{12}$	t S48 A96	(3,5,1)	(0,1)
31	Kediri	$([2,3],0,0)(1,0,0)^{12}$	t S48 A96	(3,5,1)	(0,[2])
32	Jember	$([1,3],0,0)(1,0,0)^{12}$	t S48 A96	(3,4,1)	(0,1)
33	Bali	$([1,3],0,0)(1,0,0)^{12}$	t S48	-	(0,1)
34	Nusa Tenggara Barat	$(2,0,0)(1,0,0)^{12}$	t S48	(3,3,1)	-
35	Nusa Tenggara Timur	$(2,0,0)(1,0,0)^{12}$	t S49 A36 A41 A95 A96 A108 A114 A120 A132	(3,3,1)	-
36	Kalimantan Selatan	$(2,0,0)(1,0,0)^{12}$	t S48 A95 A96	(3,2,1)	(0,[12])
37	Kalimantan Barat	$([2],0,0)(1,0,0)^{12}$	t S49 A96	(3,4,1)	-
38	Kalimantan Timur	$([2],0,0)(1,0,0)^{12}$	t S41 A96	(3,4,1)	-
39	Kalimantan Tengah	(1,0,0)(1,0,0)12	t S95 S97 A60 A132	(3,4,1)	(0,[12])
40	Balikpapan	$([1,2,3,6],0,0)(1,0,0)^{12}$	t A95 A96	-	-
41	Sulawesi Selatan	$(2,0,0)(1,0,0)^{12}$	t S49 A84	(3,5,1)	-
42	Sulawesi Tengah	$([2],0,0)(1,0,0)^{12}$	t S49 A95 A96 A119	(3,4,1)	-
43	Sulawesi Utara	$([1,3],0,0)(1,0,0)^{12}$	-	(3,4,1)	-
44	Sulawesi Tenggara	$([1,4],0,0)(1,0,0)^{12}$	t S49	(3,3,1)	(0,[11])
45	Maluku	$([1,3],0,0)(1,0,0)^{12}$	t S49 A95 A96	(3,5,1)	-
46	Maluku Utara	$(1,0,0)(1,0,0)^{12}$	t S49 A84	(3,5,1)	-
47	Papua	$([1,2,3,5,6],0,0)(1,0,0)^{12}$	t S49 A96 A120	(3,1,1)	-

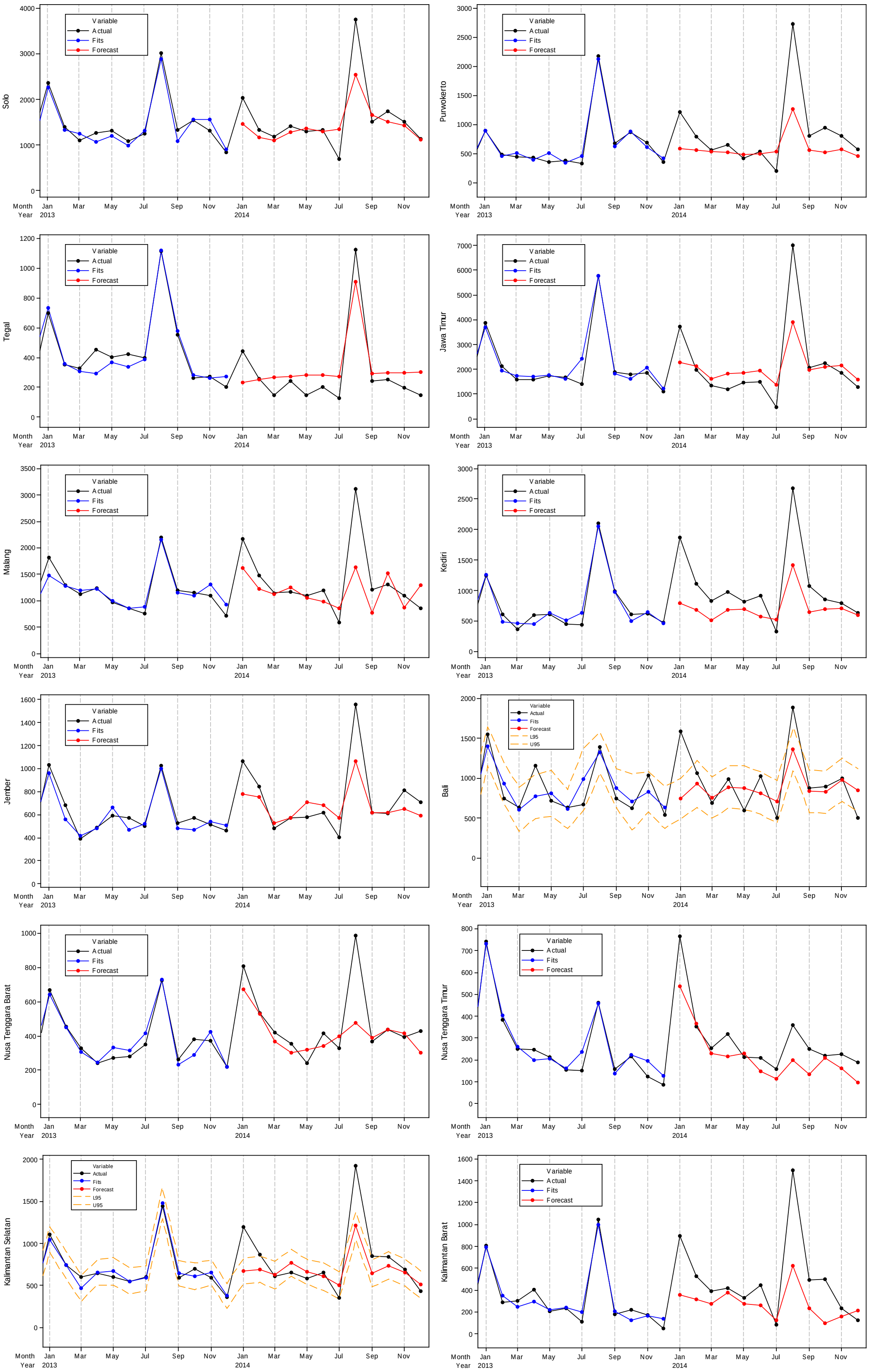
Appendix 12. Final Forecast for Currency Inflow Data



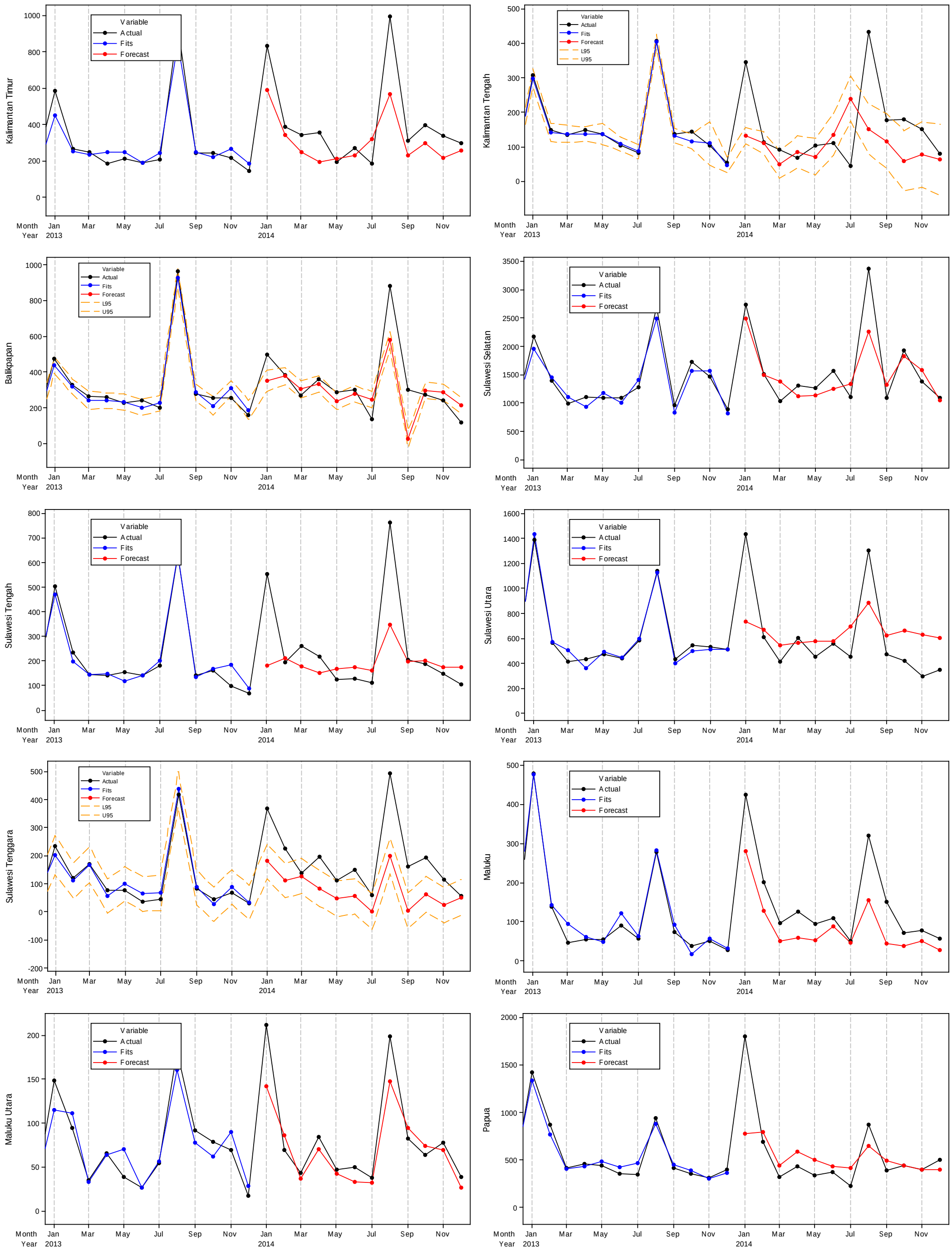
Appendix 12. (Extension)



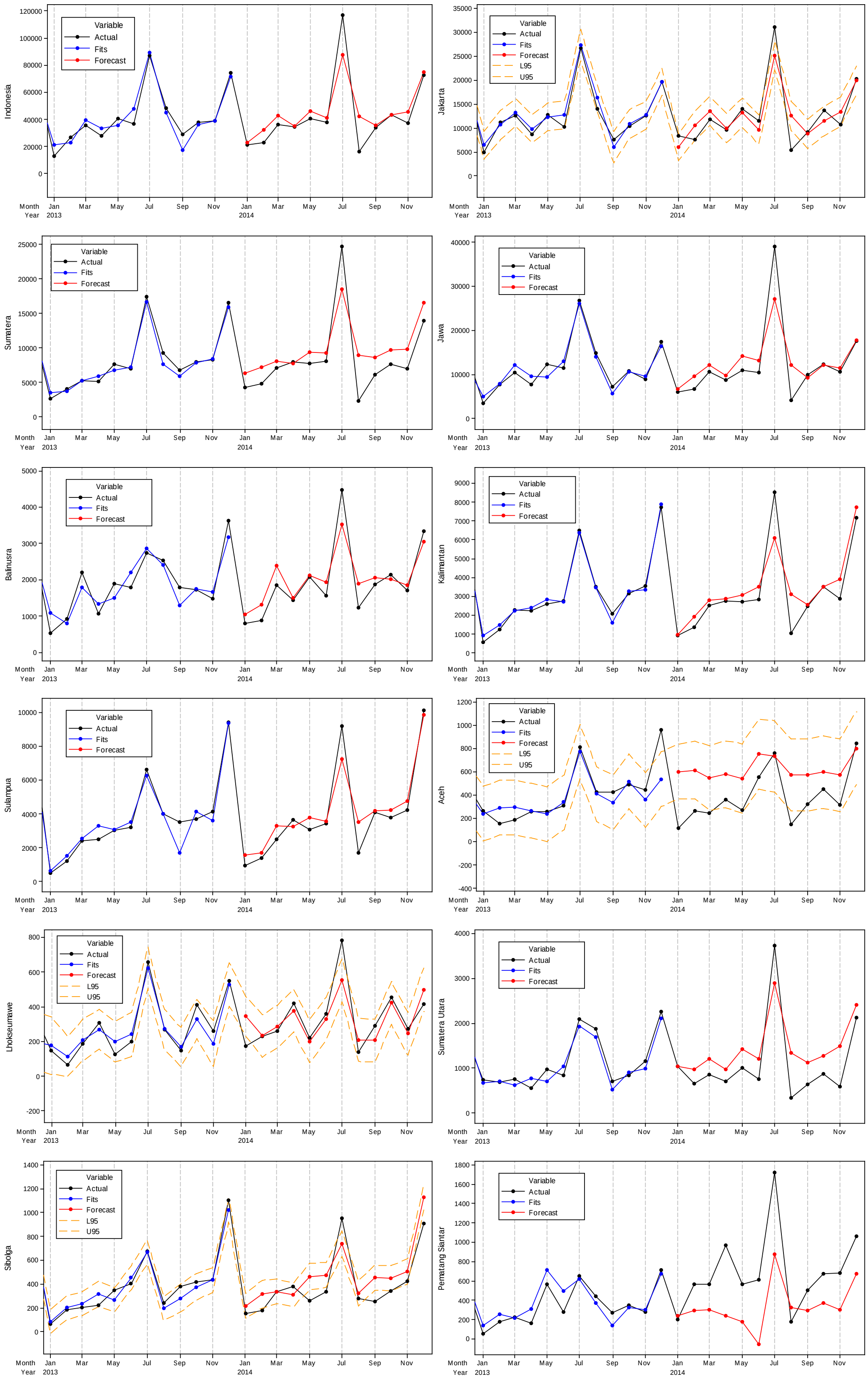
Appendix 12. (Extension)



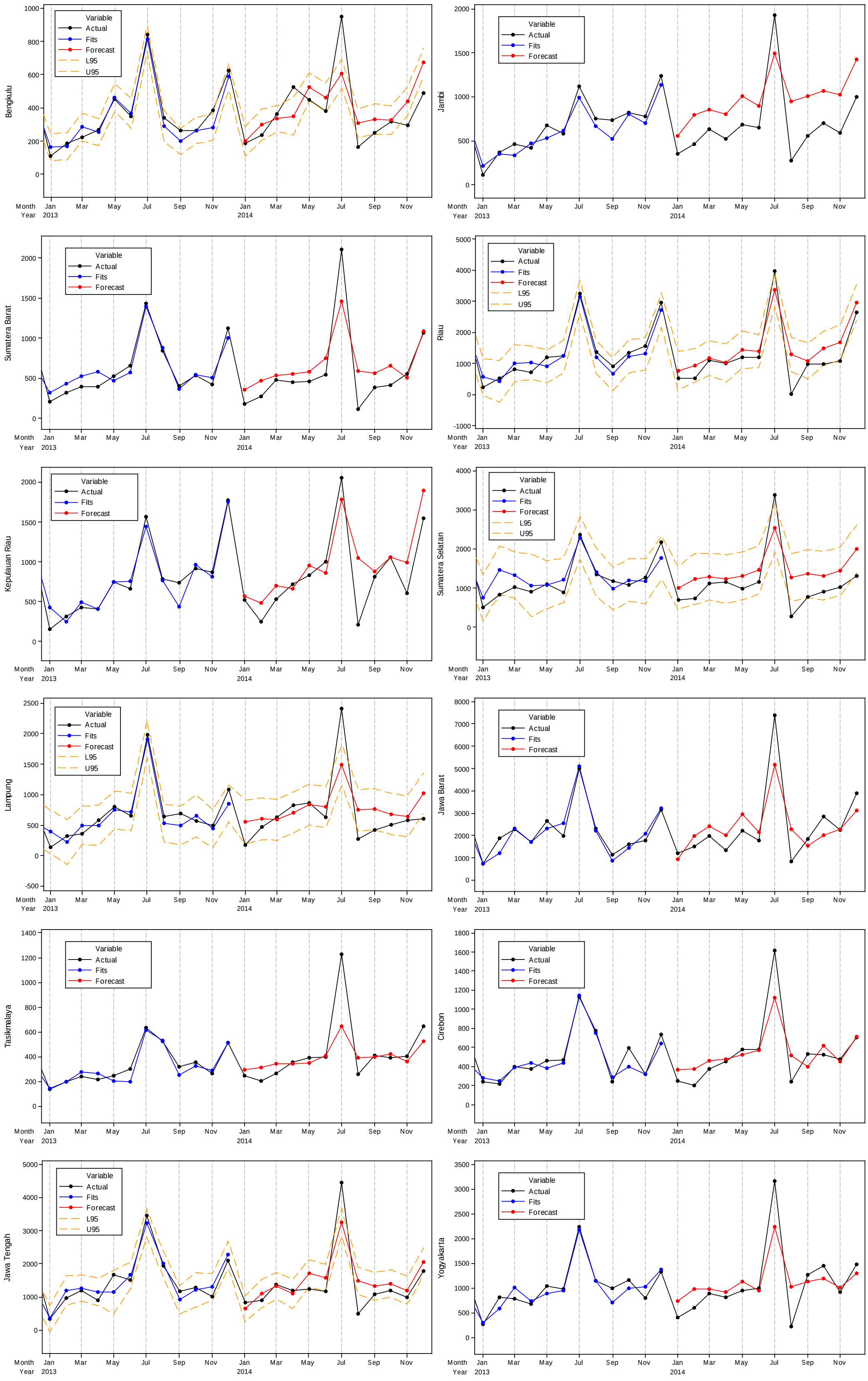
Appendix 12. (Extension)



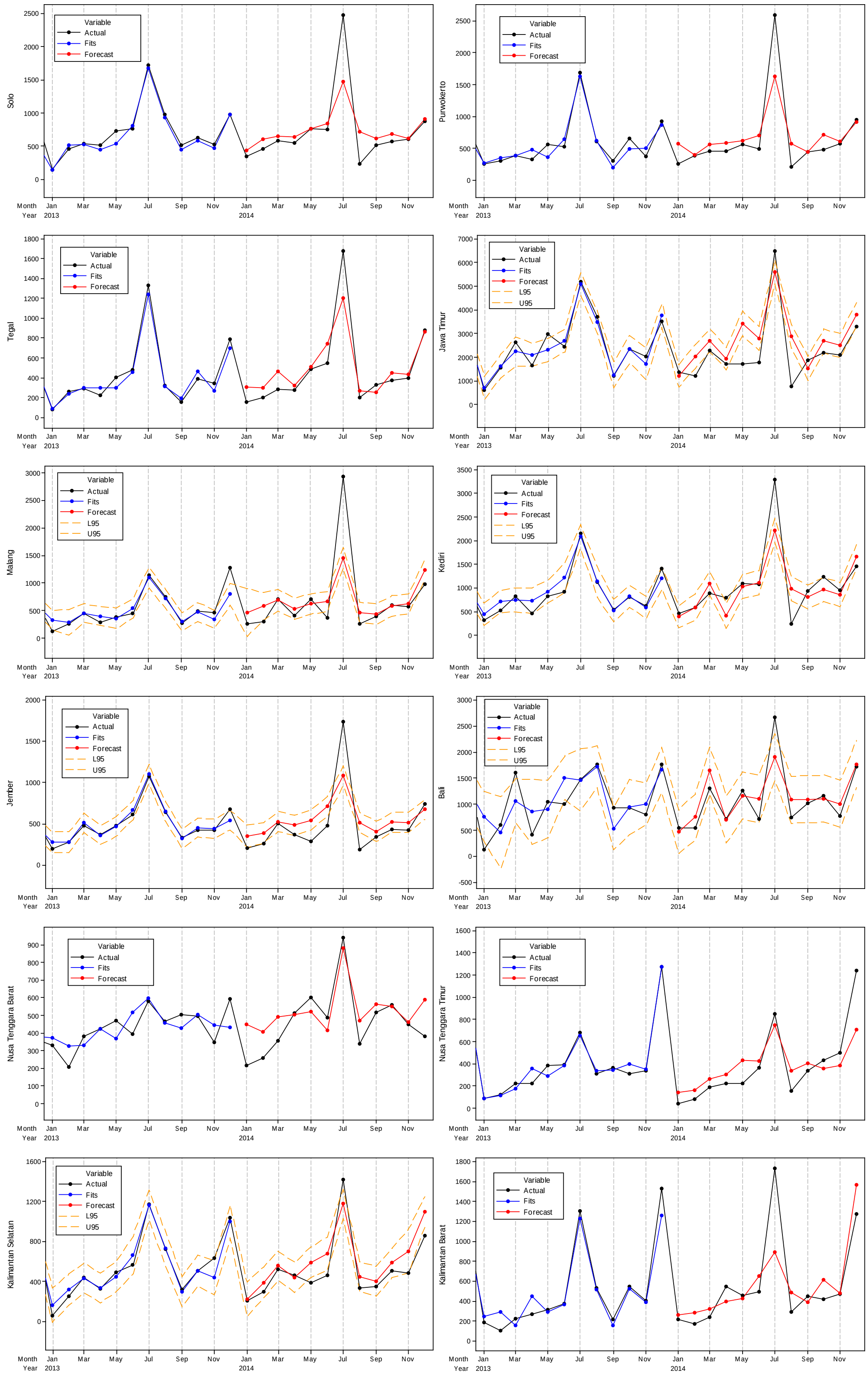
Appendix 13. Final Forecast for Currency Outflow Data



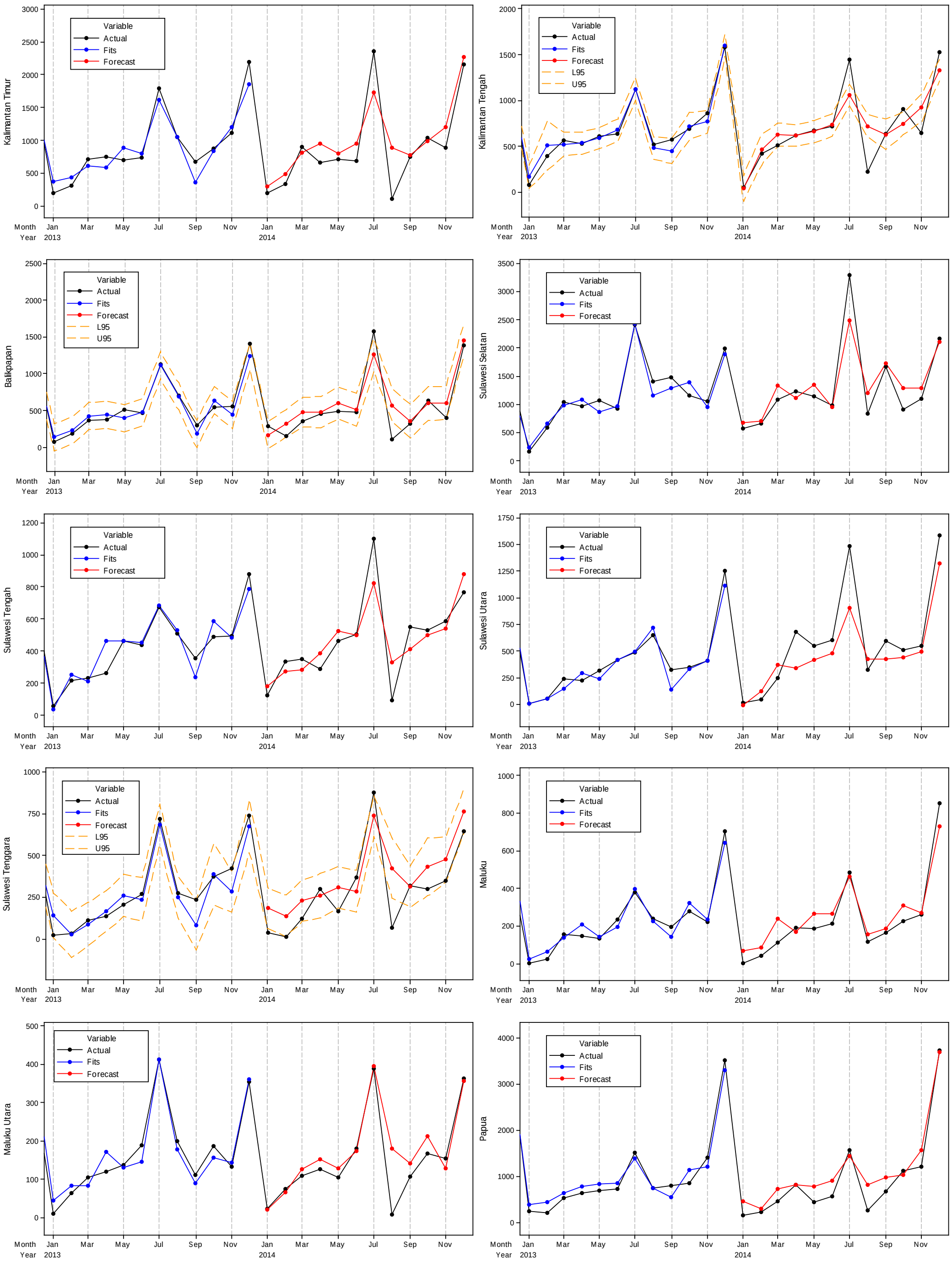
Appendix 13. (Extension)



Appendix 13. (Extension)



Appendix 13. (Extension)



CHAPTER V
CONCLUSION AND RECOMMENDATION

5.1 Conclusion

Based on the results and discussions in the previous section, there are obtained some conclusions as follows:

1. Currency inflow and outflow data have trend and seasonal component with some additive and level shift outliers. The presence of Eid al-Fitr affects currency inflow data in months containing Eid al-Fitr and the next month, whereas the outflow data are affected in months containing Eid al-Fitr and the previous month. The effects are varying based on the date when Eid al-Fitr happens. Two levels ARIMAX model can handle all of those effects, thus the forecasts can nicely fit the actual data.
2. The hybrid method implements artificial neural networks (ANN) with varying optimum number of neurons in the hidden layer for each series. Although some ARIMAX models are better than the hybrid ARIMAX-ANN model, the hybrid method could increase the accuracy of 97.8 and 87.0 percent of ARIMAX model for inflow and outflow respectively. The improvements were up to 10.26 and 10.65 percent, respectively on inflow and outflow series.
3. Hierarchical forecasting based on the best model between ARIMAX and hybrid ARIMAX-ANN gives results that the best method for forecasting hierarchical currency inflow and outflow is bottom-up method. It means that currency inflow and outflow at national level are better forecasted by summing up the forecasts at branch offices level. When the base forecasts are obtained by using only ARIMAX model, the revision by top-down with historical proportions and optimal combination method yield the best forecast respectively on currency inflow and outflow data.
4. Hybrid treatment on ARIMAX model can affects the consistency of the error variance. Even though 5 series of each inflow and outflow change from homoscedasticity to heteroscedasticity, the hybrid method can reduce the total

number of models that have heteroscedasticity from 23 to 13 on inflow data and from 25 to 17 on outflow data.

5. The error variance of the series with homoscedasticity were estimated based on the static value of MSE. Whereas, for the series with heteroscedasticity, GARCH models are implemented to forecast the conditional variance. The interval forecast based on GARCH model does not certainly become wider over time and tend to be narrower compared to the interval based on MSE, especially for long period of forecasting. Therefore, GARCH model can produce precise interval forecast for long period of forecasting.

5.2 Recommendation

From this study, there are some recommendations for the future research, such as:

1. Inaccurate forecast of ARIMAX or hybrid ARIMAX-ANN model may be caused by the presence of outliers. The outlier detection in this study only improves the fitted values for in-sample data. An intervention analysis is required to investigate the events that causes the outliers such as the policy from Bank Indonesia, thus if the same event happens in the future, the data can be forecasted more accurately. It is also important to include social and economic variables that may be different for each region, thus transfer function models are needed.
2. More studies about hybrid modeling are needed, such as the implementation of the other nonlinear models, and the effect of maximum lag implemented as the inputs in ANN. The ANN model selection from repetition in “neuralnet” procedure are still based on in-sample sum squared errors. For forecasting purposes, it will be better to uses out-of-sample criteria in the repetition.
3. Top-down method with historical proportion and optimal combination method perform well on the less accurate forecast. Accordingly, more empirical and simulation studies are needed to find out how the performance are affected by type of proportions or length of periods for calculating proportion in top-down method, and the structure or level of hierarchy in optimal combination method.

4. Even though the more accurate forecasts are obtained after hybrid modeling, the forecast intervals become unable to be constructed because there are no formula for estimating the error variance of hybrid model. Therefore, a procedure for estimating the error variance of hybrid model will be very beneficial.
5. The GARCH orders in this case are not easy to be identified. The orders identification based on portmanteau test or ACF and PACF of squared residual frequently does not yield the model that has significant parameters. It makes the model selection involves many possible model. Therefore, the GARCH order identification needs procedure that is more efficient. Other type of GARCH model also can be implemented, such as exponential GARCH (EGARCH) or threshold GARCH (TGARCH).

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BIOGRAPHY

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